AUG 21 1930
Engineering Library

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON. W.C. 2.

VOL. CL.—No. 3891] LONDON: FRIDAY EVENING, AUGUST 8, 1930 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 27th August, 1930, for ACCELERATED LOW-PRESSURE HOT WATER HEATING at the Post Office, &c., Newbury.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions.
5553.

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POST :—

M/2274.—ENGINEER REQUIRED by the GOVERNMENT of NIGERIA, for the Maintenance of the Lagos Waterworks, for two tours of 12 to 18 months' service and possible extension. Salary £720, rising to £920 a year by annual increments of £40. Free quarters and passages. Liberal leave on full salary. Candidates, 28 to 40 years of age, must be Corporate Members of the Institution of Civil Engineers and the Institution of Water Engineers. Must have had good experience in the Management of Waterworks, including Triple-expansion Pumping Machinery, Chemical Treatment and Filtration Processes, also in Modern Waste Detection Methods and in the Application of By-laws and Collection of Revenue.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/2274. 5560

Fully Experienced and capable DESIGNER REQUIRED. Applicants must possess practical workshop experience as well as thorough technical training. Initiative and imagination are required for dealing with the preparation of design and detail of components for torpedoes, and preference will be given to designers with previous experience in the design and detail of internal combustion engines. Experience in the design of up-to-date jigs and tools for small and accurate production work is also required. Applicants should not be under 30 years of age nor over 45. Commencing salary £300, rising by annual increments of £15 to £350. Civil Service cost-of-living bonus also payable; this is subject to review every six months, and at present amounts to £123 on a salary of £300 and to £135 on a salary of £350. Appointment will be terminable at 3 months' notice on either side, but good prospect of permanent employment for a really suitable man. Preference will be given to ex-Service men.—Applications should be addressed to the SECRETARY OF THE ADMIRALTY (C.E.), Whitehall, London, S.W. 1, and should be received not later than the 18th August, 1930. Candidates may subsequently be invited to attend for an interview in London, and the expenses of such attendance will not be payable from public funds.
5541

UNIVERSITY OF LONDON.

King's College.

FACULTY OF ENGINEERING.

CIVIL, MECHANICAL, ELECTRICAL and CHEMICAL ENGINEERING.

COMPLETE COURSES of STUDY, extending over three years, are arranged for the Engineering Degrees of the University of London and for the Diplomas and Certificate of the College.

POST-GRADUATE COURSES in CIVIL, MECHANICAL, ELECTRICAL and CHEMICAL ENGINEERING are also provided.

HEADS OF DEPARTMENTS :

Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering (Dean).
C. H. LOBBAN, D.Sc., A.M. Inst. C.E., Reader in Civil Engineering.
Professor J. K. CATTERSON-SMITH, M.Eng., M.I.E.E., Electrical Engineering.
F. S. ROBERTSON, M.I.E.E., Senior Lecturer in Electrical Engineering.
Professor G. COOK, D.Sc., M.I. Mech. E., M. Inst. C.E., Mechanical Engineering.
S. J. DAVIES, M.Sc., Ph.D., M.I. Mech. E., Reader in Mechanical Engineering.
H. W. CREMER, M.Sc., F.I.C., M.I. Chem. E., Chemical Engineering.
Professor S. A. F. WHITE, M.A. } Mathematics.
Professor A. E. JOLLIFFE, M.A. }

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the four Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 5448

University of Birmingham.

FACULTY OF SCIENCE.
ENGINEERING DEPARTMENT.

I.—MECHANICAL ENGINEERING.
"Chance" Professor: F. W. BURSTALL, M.Sc., M.A. (Cantab.), M.I. Mech. E.
II.—CIVIL ENGINEERING (AND TOWN PLANNING).
"Beale" Professor: CYRIL BATHO, M.Sc., D.Sc. (McGill), B.Eng., A.M. Inst. C.E.
III.—ELECTRICAL ENGINEERING.
Professor: WM. CRAMP, D.Sc., M.I.E.E.

The FULL COURSES EXTEND OVER FOUR YEARS, and Students who enter after matriculation and pass successfully the examinations at the end of each year will be ENTITLED TO THE DEGREE OF BACHELOR OF SCIENCE IN ENGINEERING.

The SESSION 1930-31 COMMENCES on OCTOBER 6th, 1930.

For detailed syllabus of the Faculty with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the REGISTRAR. 5445

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Protection of Alternating Current Generators. (P. 138)
THE ENGINEER, 8-8-30.

A Newsprint Mill in Nova Scotia. (P. 140)
THE ENGINEER, 8-8-30.

Locomotive No. 10,000. (P. 149)
THE ENGINEER, 8-8-30.

Engineering Degree Courses: Suggested Modifications. (P. 150)
(W. N. ELGOOD.) THE ENGINEER, 8-8-30.

Electric Score Boards at Wimbledon. (P. 145)
(R. A. SMITH.) THE ENGINEER, 8-8-30.

Trolley Omnibuses. (P. 152)
THE ENGINEER, 8-8-30.

62,500 kVA Turbo-Generators. (P. 144)
THE ENGINEER, 8-8-30.

A Multi-Language Interpretation System. (P. 154)
THE ENGINEER, 8-8-30.

Wages and Prices. (P. 149)
THE ENGINEER, 8-8-30.

INDEX TO ADVERTISEMENTS, PAGE 77.

PUBLIC NOTICES

University of Birmingham.

DEPARTMENT OF METALLURGY.

"FEENEY" PROFESSOR: D. HANSON, D.Sc.

The course of study covers three years and leads to the Degree of B.Sc. in Metallurgy. There is also an Honours School. Special attention is devoted to Iron and Steel, Copper, Brass, Metallography, the needs of local industries and to preparation for Colonial and Foreign Posts.

The SESSION 1930-31 COMMENCES on OCTOBER 6th, 1930.

Research and other Scholarships.

For detailed syllabus apply to the REGISTRAR.
5446

University of Bristol.

FACULTY OF ENGINEERING.

(Provided and Maintained by the MERCHANT VENTURERS' TECHNICAL COLLEGE).
Vice-Chancellor: T. LOVEDAY, M.A., LL.D.
Dean of the Faculty:
ANDREW ROBERTSON, D.Sc., M.I. Mech. E., M. Inst. C.E.

DEPARTMENTS.

CIVIL ENGINEERING: Prof. A. J. SUTTON PIPPARD, M.B.E., D.Sc., M. Inst. C.E., M.I. Mech. E., F.R.Ae.S.
MECHANICAL ENGINEERING: The DEAN.
ELECTRICAL ENGINEERING: Prof. DAVID ROBERTSON, D.Sc., M.I.E.E.
AUTOMOBILE ENGINEERING: Prof. W. MORGAN, B.Sc., M.I.A.E.
MATHEMATICS: Prof. E. S. BOULTON, M.A., B.Sc.
GEOLOGY: Prof. S. H. REYNOLDS, M.A., Sc.D.
CHEMISTRY: Prof. F. FRANCIS, D.Sc., Ph.D., F.I.C.

Complete Courses of Study extending over three years leading to the University Degree or Diploma in Civil, Mechanical, Electrical or Automobile Engineering.

Full particulars of Courses and of the University Halls of Residence may be obtained on application to the REGISTRAR, M.V.T. College, Bristol.

The SESSION 1930-31 COMMENCES on OCTOBER 3rd. 5363

PUBLIC NOTICES

University College of Swansea.
(A Constituent College of the University of Wales).

Principal: C. A. EDWARDS, D.Sc., F.R.S.

APPLIED SCIENCE DEPARTMENTS.

ENGINEERING.

Professor: FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: A. A. FORDHAM, B.Sc. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Assistant Lecturer: J. SELWYN CASWELL, M.Sc. (Wales), A.M.I. Mech. E.

METALLURGY.

Professor: C. A. EDWARDS, D.Sc. (Manchester), F.R.S.
Assistant Professor: L. TAVERNER, A.R.S.M.
Lecturer: L. B. PFEIL, D.Sc. (Lond.), A.R.S.M.
Assistant Lecturers: J. C. JONES, M.Sc. (Wales). R. GRIFFITHS, B.Sc. (Wales).

The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to works of practical educational value to the Students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (A) Civil Engineering, (B) Mechanical Engineering, (C) Electrical Engineering, (D) Metallurgy; and (2) for Diplomas of the College in (A) Civil Engineering, (B) Mechanical Engineering, (C) Electrical Engineering, (D) Metallurgy.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such Classes.

Entrance Scholarships will be offered for competition in September, 1930.

Particulars concerning admission to the College and of the Entrance Scholarships may be obtained from the undersigned.

EDWIN DREW,
Registrar.
Singleton Park, Swansea. 5364

PUBLIC NOTICES

University of Manchester.

FACULTY OF SCIENCE.

DEPARTMENT OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

COMPLETE COURSES of STUDY, extending over three years, lead to the University Degree in Civil, Mechanical and Electrical Engineering. Students who have shown exceptional ability during the first year are admitted to the Honours Courses. A prospectus giving full information may be obtained on application to the REGISTRAR.

The SESSION COMMENCES on THURSDAY, OCTOBER 2nd.

DEPARTMENTS.

Professor A. H. Gibson, D.Sc., M. Inst. C.E., M.I. Mech. E. (Engineering).
Professor Robert Beattie, D.Sc. (Electrical Engineering).
Professor D. R. Hartree, M.A., Ph.D. (Applied Mathematics).
Professor L. J. Mordell, B.A., M.Sc., F.R.S. (Pure Mathematics).
Professor Arthur Lapworth, D.Sc., LL.D., F.R.S. (Chemistry).
Professor W. L. Bragg, M.A., M.Sc., F.R.S., Nobel Laureate (Physics).
Professor F. C. Thompson, M.Sc., D.Met. (Metallurgy).
Professor O. T. Jones, M.A., D.Sc., F.R.S. (Geology).
5529

The Royal Technical College, GLASGOW.

DEPARTMENTS OF ENGINEERING.

MECHANICS AND MECHANICAL ENGINEERING: Professor ALEXANDER L. MELLANBY, D.Sc., M.I. Mech. E.
Associate Professor WILLIAM KERR, Ph.D., A.R.T.C., M.I. Mech. E.
ELECTRICAL ENGINEERING: Professor STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.
CIVIL ENGINEERING: Professor GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
MINING ENGINEERING: Professor DANIEL BURNS, M. Inst. M.E.
CHEMICAL ENGINEERING: Professor of Technical Chemistry: THOMAS GRAY, D.Sc., LL.D., Ph.D., F.I.C.

Complete courses of instruction are provided, qualifying for the Diploma and Associateship of the College and for the Degree of B.Sc. in Engineering of Glasgow University.

Composition fee, 25 guineas per annum.

SESSION 1930-31 BEGINS on TUESDAY, SEPTEMBER 23rd.

Calendar, by post 3s., and prospectus, gratis, may be obtained on application to the SECRETARY.
5365

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :—

6834 DRAWBARS.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Wednesday, 6th August, 1930.

A fee of 20s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Friday, 22nd August, 1930.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. GRANT,
5539 Secretary.

City of Carlisle.
WIDENING OF EDEN BRIDGE AND APPROACHES.

TENDERS are INVITED for the WIDENING, in Reinforced Concrete with Stone Facing, of EDEN BRIDGE, CARLISLE, consisting of Five Arches, each 65ft. span, together with Foundations, Reinforced Concrete Approach Walls, Road Works, etc.

General conditions, specification, form of Tender, etc., may be obtained at the office of the undersigned on and after 6th August, 1930, when plans and sections may also be inspected, on payment of £5 5s. (which sum will be returned on the receipt of a bona fide Tender, and the whole of the documents supplied).

Tenders, endorsed "Eden Bridge" (which will only be accepted from contractors who have had considerable experience in Reinforced Concrete Bridge Works), must be returned to this Office not later than 12 Noon on 1st September, 1930.

The Council do not bind themselves to accept the lowest or any Tender, and parties tendering must do so at their own cost.

PERCY DALTON
A.M. Inst. C.E., A.R.I.B.A.,
City Engineer and Surveyor.
18, Fisher-street,
Carlisle,
28th July, 1930. 5508

PUBLIC NOTICES (continued) Page 2.
SITUATIONS OPEN Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 78.
MISCELLANEOUS. Page 2.
EDUCATIONAL, Page 2.
MACHINERY, &c., WANTED, Page 78.
PATENTS, Page 78.
FOR SALE, Pages 2 and 4.
AGENCIES, Page 2.
WORK WANTED, Page 78.
FOR HIRE, Page 78.

For Advertisement Rates see Leader Page.

PUBLIC NOTICES

Bombay, Baroda and Central India Railway Company.

The Directors are prepared to receive up to Noon on Friday, 29th August, TENDERS for the SUPPLY of :
1. AXLES for CARRIAGES and WAGONS.
2. CRANK and STRAIGHT AXLES for LOCOMOTIVES.
3. COPPER FIRE-BOX PLATES.
4. LAMINATED BEARING SPRINGS.
5. TYRES for CARRIAGES and WAGONS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of £1 each for Nos. 2 and 3, and 10s. each for Nos. 1, 4 and 5 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1,
1st August, 1930. 5542

Newbury Corporation Water Undertaking.

WATER PUMPING PLANT.

TENDERS are INVITED by the Newbury Corporation for the SUPPLY and INSTALLATION at the Corporation's Water Pumping Station at Fisher's-lane, in the Parish of Cold Ash (near Newbury), of :—
(1) TWO ELECTRICALLY DRIVEN BORE-HOLE PUMPS, together with BOOSTERS, each with a capacity for pumping 10,000 gallons of water per hour with a total head of 508ft., excluding friction.
(2) All necessary ELECTRICAL SWITCHGEAR, TRANSFORMERS, &c.

A copy of the specification (and any other information) may be obtained from Mr. W. H. D. Lester, the Consulting Engineer, at No. 18, Cheap-street, on payment of £1 1s., which will be refunded on receipt of a bona fide Tender.

The lowest or any Tender will not necessarily be accepted. The successful tenderer will be required to enter into a contract and give security for the due execution of the work.

Sealed Tenders, endorsed "Tenders for Pumping Plant," must be addressed to and must reach the undersigned not later than the 1st September, 1930.

S. WIDDICOMBE,
Town Clerk.

Municipal Buildings, Newbury. 5536

South Indian Railway Company, Limited.

The Directors are prepared to receive TENDERS for the SUPPLY of—
(1) SOLID DRAWN STEEL BOILER TUBES.
(2) SPARE PARTS of CARRIAGES and WAGONS.
(3) HELICAL and VOLUTE SPRINGS, and
(4) LAMINATED SPRINGS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Solid Drawn Steel Boiler Tubes," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 22nd August, 1930.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of Specifications Nos. 1, 2, and 3, and of 10s. for each copy of Specification No. 4.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France,
Westminster, S.W. 1,
6th August, 1930. 5562

Trinity House, London.

TENDERS FOR BUILDING A NEW LIGHT VESSEL.

TENDERS are INVITED for the CONSTRUCTION of a LIGHT VESSEL, length 96ft. 9in., breadth 25ft., depth moulded 14ft. 3in., of Steel or, alternatively, Composite Construction.

Forms of Tender, specifications and drawings may be obtained at Trinity House, on any weekday except Saturday, between the hours of 10.30 a.m. and 4.30 p.m., on payment of a deposit of £1 (to be refunded on receipt of a bona fide Tender and the return of all the documents furnished).

Tenders, in sealed envelopes, marked outside "Tender for No. 87 Light Vessel," are to be delivered to the Secretary, Trinity House, Tower Hill, London, E.C. 3, not later than 10 a.m. on Thursday, 4th September, 1930.

The Corporation of Trinity House do not bind themselves to accept the lowest or any Tender.

M. K. SMITH,
5540 Secretary.

City of Liverpool.

APPLICATIONS are INVITED for the following TEMPORARY APPOINTMENTS in the City Engineer's Department :—
(A) ENGINEERING ASSISTANT (£5 per week).
(B) JUNIOR ENGINEERING ASSISTANT (£3 10s. per week).

Applicants should be good draughtsmen, surveyors and levellers, and as regards the former appointment experience in connection with tramway permanent way would be considered an advantage.

Applications, stating age and qualifications and accompanied by copies of not more than two recent testimonials, to be forwarded through the post, addressed to the undersigned, endorsed "Engineering Assistant" or "Junior Engineering Assistant," as the case may be, so as to arrive not later than the first post on Wednesday, 20th August.

Canvassing of members of the City Council will be regarded as a disqualification.

WALTER MOON,
Town Clerk.

Municipal Buildings, Liverpool,
31st July, 1930. 5549

Wanted, an Engineer or Contractor's agent, capable of carrying out, under the direction of the City Engineer, the Construction of Sewers, Bridges, Retaining Walls, etc. Salary £650 per annum.—Applications, stating age, experience, etc., to be sent to the CITY ENGINEER, Town Hall, Manchester, not later than 10 a.m., Friday, 15th August, 1930. 5500

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

CONTRACTORS' ASSISTANT ENGINEER REQUIRED immediately, with experience in Railway Construction.—Address, stating age, experience and salary required, 5558, The Engineer Office. 5558 A

CHIEF DESIGNER for Instrument Transformers REQUIRED for large Electrical Engineering Firm.—Address, stating age, salary required, and full particulars of experience, 5503, The Engineer Office. 5503 A

ENGINEER DESIGNER REQUIRED, with Wide experience in design and development of successful modern Compression Ignition Engines for use in Road Motor Vehicles. Midland district.—Address, 5466, The Engineer Office. 5466 A

FIRST-CLASS MECHANIC and GENERAL MACHINE CHARGE HAND REQUIRED in General Engineering Works. Must have had experience in High-pressure Work, Millwrighting and Machine Tools.—Address, stating very fullr experience, salary required, age, and give copies of testimonials, 5555, The Engineer Office. 5555 A

A Business Opportunity.

There is an opening in — MANCHESTER LEEDS GLASGOW LEICESTER HUDDERSFIELD SHEFFIELD NEWCASTLE.

PARKER PROCESS

for the establishment of the highly profitable business of Rust-Proofing iron and steel products by the famous Parker Process.

Many of the largest concerns in this country are operating the Parker Process under licence, for the treatment of their own products. In every industrial centre there are large numbers of small manufacturers whose requirements are not sufficiently large to justify the use of a plant for their own products, and who, therefore, find it more economical to have Parkerizing undertaken at a commercial plant devoted specially to this work.

The plant necessary to start up a Rust-Proofing business of this description does not entail a large capital outlay. Exclusive rights are given and we will co-operate in establishing the business. Full details on request.

Write to :—

THE Pyrene COMPANY LIMITED,

GREAT WEST ROAD, BRENTFORD, MIDDLESEX.

Telephone : Ealing 6012 (7 lines). Telegrams : "PYRENE, BRENTFORD."

SITUATIONS OPEN (continued)

EVANS LIFTS, Ltd., Prospect-road, Leicester, REQUIRE experienced ENGINEER, capable of testing and handing over installations. Splendid prospects to young, energetic and efficient man.—Apply in confidence to GENERAL MANAGER. 5548 A

INDIA.—TRAVELLING REPRESENTATIVE of proved selling ability REQUIRED by Calcutta firm holding important agencies. Applicants having previous experience in Pneumatic Machinery and Tools preferred, also a knowledge of Oil Engines, Pumping Plants, Machine Tools, and Steels. Capable of advising, estimating and supervising erection if necessary. Salary Rupees 750 p.m., with expenses and commission. Single. Age (about) 30 ; four years' agreement.—Write, giving full details of previous experience, with copies of testimonials, to "V. C.," c.o. Charles Barker and Sons, Ltd., 31, Budge-row, London, E.C. 4. 5561 A

LARGE INDUSTRIAL GROUP REQUIRE Qualified CHEMIST to act as Assistant to Works Manager in Midlands.

Actual experience of Dyeing, Plastic Moulding, Hydraulic Machinery and Machine Shop Practice a definite advantage.

Salary from £300 per annum up, according to qualifications. Excellent opportunity for rapid advancement to right man. No application considered not containing fullest particulars of past and present record.—Replies, FYLEMAN, Leith House, Gresham-street, E.C. 2. 5563 A

PATENT AGENT, Registered, WANTED, as MANAGER for Provincial International Patent and Trade Mark Office. Salary not less than £600 per annum, according to qualifications.—Address, 5550, The Engineer Office. 5550 A

WANTED, an Experienced MECHANICAL DRAUGHTSMAN, with a sound knowledge of General Engineering and having good technical abilities, REQUIRED by a firm of General Engineers in the Midlands.—Address, stating age, experience and salary required, 5559, The Engineer Office. 5559 A

DRAUGHTSMAN (London), Experienced in Design and Details of Plate and Steel Constructional Work, also Pipe Arrangements and Condenser Details. State age, experience, including shop work and salary.
Address, 5518, The Engineer Office. 5518 A

LEADING DRAUGHTSMAN, Having Sound Mechanical and Electrical experience with design of large Power Transformer Apparatus.—Address applications in confidence, stating age, experience, and salary expected, 5442, The Engineer Office. 5442 A

LEADING FIRM of Lift Manufacturers REQUIRE DESIGN DRAUGHTSMAN ; must be experienced electrically and mechanically.—State experience and salary required to EVANS LIFTS, Ltd., Prospect-road, Leicester. 5547 A

SENIOR and JUNIOR TOOL DRAUGHTSMEN, with knowledge of all types of Jigs, Tools and Gauges used in production of high-grade Telegraph Instruments (similar to typewriters and calculating machines).—Write, stating age, experience, and salary, to CREED and CO., Ltd., Telegraph Engineers, East Croydon. 5551 A

WANTED, an ASSISTANT FOREMAN STEEL MOULDER for large Steel Foundry in Calcutta. Applicants must have had at least 5 years in charge of a modern Steel Foundry producing Light and Medium Weight Castings on a Mass Production basis. Experience with latest Moulding Machine practice essential ; also Pattern Making.

Salary Rs. 500 to Rs. 600 per month. Three years' agreement. Second-class passage out and home.

Apply, No. 492, Advertiser Office, Dundee. 5557 A

SITUATIONS WANTED

AN Experienced ENGINEER of Good Address DESIRES RESPONSIBLE APPOINTMENT to conduct economic cost studies, planning, estimates, operating statistics, correspondence.—Address, P149, The Engineer Office. P149 B

BUYER, with Successful Record, Who is a Trained engineer, specialising in latest practice boiler-house equipment, WISHES to PLACE his SERVICES at the DISPOSAL of an INTERESTED PARTY.—Address, P151, The Engineer Office. P151 B

CIVIL ENGINEER (27), B.Sc., with Year's Experience in municipal office as an assist. engineer, DESIRES POST without remuneration in East-bound steamer.—Address, P148, The Engineer Office. P148 B

SITUATIONS WANTED (continued)

ENGINEER, Age 27½, A.M.I. Mech. E., 1st Class B.O.T. Certificate, experience modern power plant, at present engaged as engineer-surveyor, DESIRES progressive POSITION.—Address, P141, The Engineer Office. P141 B

ENGR., Age 45, 1st Class B.O.T. Cert., 18 Years' sea experience, 3 years as chief engr., 5 years ashore as refrig. engr., SEEKS CHANGE, any capacity.
Small private means ; would accept very moderate salary.
Address, P132, The Engineer Office. P132 B

ENGINEER, 23, Disengaged Aug. 9th, SEEKS POSITION with Responsibility. Highest Refs., Honours Degree, G. Inst. Mech. E., 5 years works, 1 year technical staff inspecting machinery, knowledge Spanish.—Address, P144, The Engineer Office. P144 B

ENGINEER, 34, Designer, Steel and Reinforced Concrete, extensive site experience, DESIRES APPOINTMENT. Civil engineering training ; would supervise ; 6 yrs. control.—Address, P142, The Engineer Office. P142 B

ENGINEER (30), FULLY EXPERIENCED, EXCELLENT GENERAL AND TECHNICAL EDUCATION, FLUENT KNOWLEDGE OF FRENCH AND GERMAN, WITH MANY YEARS' CONTINENTAL EXPERIENCE, WISHES TO SEVER PARTNERSHIP IN SMALL FIRM TO TAKE UP A COMMERCIAL POSITION OR SOUND REPRESENTATION AT HOME OR ABROAD.—Address, P143, The Engineer Office. P143 B

ENGINEER, 20 Years' Experience, General and mechanical engineering, design, lay-out, erection, installations, particularly for liquids, good commercial experience.—Address, P153, The Engineer Office. P153 B

GENTLEMAN, A.M.I.C.E., M.I.M.E., Proceeding on trip to New Zealand, WISHES UNDERTAKE COMMISSIONS, Representation Firms, Negotiation Agencies, &c.—A. E. KIDNER, 53, Victoria-street, Westminster, S.W. 1. P150 B

GO-AHEAD YOUNG MAN (21), Matriculated, Commercial education, thorough knowledge French and Italian, good technical training, one year practical experience, DESIRES FURTHER EXPERIENCE with mechanical engineering firm. Very modest remuneration.—Address, P152, The Engineer Office. P152 B

SALES, PUBLICITY, GENERAL CONSTRUCTION, SURVEYS, experienced England, America, Near and Mid-East ; specialist fire-proof floors, pumice concrete, roads, pipe lines, organising, qualified. Position Sales, General, or any suitable capacity, anywhere ; age 39.—Address, 154, The Engineer Office. 154 B

STRUCTURAL STEEL WORK. — CHIEF DRAUGHTSMAN (33) SEEKS CHANGE. Nine years' London experience, contracting and consulting, including large theatre work. Full responsibility.—Address, P102, The Engineer Office. P102 B

AGENCIES

WANTED, AGENTS with Established Connections amongst Steam Users to introduce Boiler-house speciality.—Address, 5565, The Engineer Office. 5565 D

WOODEN PULLEYS.

COMPETENT MANUFACTURERS in Germany, specialising in the above, WISH to COMMUNICATE with DEALERS in ENGLAND, who will BUY STOCK on own account and who can DISPOSE of LARGE QUANTITIES regularly.

Please write, with references from German firms, to Box L.D. 3669, c/o Rudolf Mosse, Ltd., 125/130, Strand, London, W.C. 2. 5554 D

EDUCATIONAL

Correspondence Courses
OF PREPARATION FOR THE
Examinations of the
INST. OF CIVIL ENGINEERS,
INST. OF MECH. ENGRS.,
INST. OF STRUCTURAL ENGRS.,
UNIVERSITY OF LONDON, &c.,
are personally conducted by
Mr. Trevor W. Phillips,
B.Sc., Honours, Engineering, London University, Assoc. M. Inst. C.E., A.M.I. Struct. E., M.R.S.I., F.R.S.A., Chartered Civil Engineer, &c.
For full particulars and advice apply to :—36, DALE-STREET, LIVERPOOL (Tel., Bank 1118). LONDON OFFICE : 65, CHANCERY-LANE, W.C. 2. Ex.

EDUCATIONAL

1929 EXAMINATION RESULTS.

The T.I.G.B. maintains its Splendid Exam-Success Record.

At all the 1929 Professional Examinations—A.M.Inst.C.E., A.M.I.Mech.E., A.M.I.E.E., etc.—the candidates who were trained by The T.I.G.B., obtained a Pass Percentage of over 90%.

The T.I.G.B.'s policy of furnishing the highest possible standard of Tutorial Service has brought about a large increase in enrolments both from bona fide exam. candidates and from other keen students. T.I.G.B. TRAINING IS BEING CHOSEN BECAUSE IT IS OBVIOUSLY PRODUCTIVE OF SATISFACTION AND SUCCESS. Therefore, whatever your aim may be—a Recognised Professional Qualification—or the Special Technical Knowledge needed in a responsible post—you can select the appropriate T.I.G.B. course with complete confidence. The T.I.G.B. guarantees Training until Successful.

WRITE TO-DAY for FREE copy of "The Engineer's Guide to Success," 124 pages, containing the widest selection of home-study engineering courses in the world, and mention the branch, post or qualification that interests you.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN (*Established* 1917).

76, Temple Bar House, London, E.C. 4.

MISCELLANEOUS

ENGINEERS
CAN'T WE GET TOGETHER?

All we ask is the chance to prove that you can earn £300, £400, £500 per year and more. Other men are doing it, and you can do the same. We have an unrivalled and world-wide organisation waiting to help you, whether you be novice or expert. If you wish for something more than a "bread-and-butter" job you owe it to yourself to investigate our Service. Our handbook,

"ENGINEERING OPPORTUNITIES,"

has pointed the way to better things to over 20,000 of your fellows. It contains details of A.M.I. Mech. E., A.M.I.C.E., A.M.I.E.E., A.M.I.A.E., A.M.I. Struct.E., C. & G., G.P.O., &c., Exams., and outlines Home-Study Courses in all branches of Electrical, Mechanical, Motor and Wireless Engineering. In a brilliant article Professor A. M. LOW shows clearly the chances you are missing. The Book and our Advice are quite free.

We guarantee "NO PASS—NO FEE." Don't miss this opportunity. Send a postcard NOW (state Branch, Post or Exam.).

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY.

22, SHAKESPEARE HOUSE, 29, OXFORD STREET, LONDON, W. 1.
P155 I

TRACINGS AND DRAWINGS.—DRAUGHTSMAN is open to EXECUTE TRACINGS, SCALED DRAWINGS from dimensioned sketches, &c. Moderate, prompt. Prints arranged for, if desired.—Address, P95, The Engineer Office. P95 I

FOR SALE

BOILERS, TANKS and AIR RECEIVERS.

New, several, 11ft. long by 5ft., Recs., 80 lb. W.P.
Lancashire Boiler, 30ft. by 7ft., 80 lb. W.P.
Cornish Boiler (1915), 24ft. by 6ft. 6in., 80 lb. W.P.
TANKS (Boiler Shells), 30ft. by 8ft., extra heavy.
Ditto 30ft. by 7ft.

H. & T. DANKS (Netherton), LTD.,
Boilermakers and Engineers, Netherton, DUDLEY.
4722 G

ECONOMIC TYPE BOILER, by Davey, Paxman, 14ft. by 8ft. 7in., to re-insure at 160 lb. pressure. Perfect condition. Together with Pumps, Softening Plant, &c. &c.
Very low price to save second removal.

JOSEPH PUGSLEY and SONS, LTD.,
Bridge House, Lawrence Hill, Bristol.
Telephone, 9139 (3 lines). 5531 G

FLANGE FACING and DRILLING MACHINE, with back-geared headstock, fitted with face-plate and adjustable tool holders, for flanges up to 16in. dia., table 24in. by 24in. by 20in., cross traverse 10in., longitudinal traverse 12in., and countershaft.
FLANGE FACING, DRILLING and SCREWING MACHINE, to drill up to 3/8in. dia., 1¼in. deep, screw to 8in. dia., face from 2½in. to 16in. dia., two countershafts, by J. Holroyd and Sons.
JOHN CASHMORE, GREAT BRIDGE, STAFFS.

THOS. W. WARD LTD.

Sondermann and Stire HORIZONTAL BORING and FLANGE TURNING MACHINE, all geared, s.p.d., boring head 35½in. dia., max. dia. for turning flanges 39in., max. dia. for boring 19½in.
Bullard 36in. swing SCREW-CUTTING VERTICAL BORING and TURNING MILL, with side head.
Brown and Sharpe No. 2A UNIVERSAL MILLING MACHINE.
No. 3 Wotan UNIVERSAL MILLER, with Dividing Heads, w.s. of table 49in. by 13in.
No. 10 Ruston-Hornsby STEAM DRAGLINE NAVVY, mounted on CATERPILLARS, separate slewing engines, 120 lb. w.p.
Priestman DOUBLE ROPE GRAB, about 55 cubl feet capacity.
Priestman DOUBLE ROPE GRAB, about 47/42 cubic feet capacity.
TWO LANCASHIRE BOILERS, 30ft. by 8ft. 6in., re-insure 150 lb. pressure.
ONE CORNISH BOILER, 14ft. by 6ft., re-insure 80 lb. pressure.
LARGE STOCK of Very Good Second-hand FLAT-ENDED CIRCULAR BOILER STORAGE TANKS.
ASK FOR "ALBION" MACHINERY CATALOGUE.
ALBION WORKS, SHEFFIELD. Ex.

For continuation of For Sale Advertisements see page 4.

LOCOMOTIVE . MARINE . STATIONARY
"M.L.S."
SUPERHEATERS
To suit all requirements.
Specialists in Design and Manufacture
The **SUPERHEATER**
COMPANY LIMITED
BUSH HOUSE, ALDWYCH, W.C. 2.

A Seven-Day Journal

The New Cunard Liner.

WHEN referring in our Journal note of May 30th to the Cunard Line's decision to entrust John Brown and Co., Ltd., of Clydebank, with the building of the new 75,000-ton liner, we mentioned that some vital questions would have to be settled before the contract was finally placed. The Cunard Steam Ship Company, Ltd., now announces that the most important of these questions has been settled by the agreement of the Board of Trade, with the approval of the Treasury, to undertake the insurance of such a portion of the steamer as cannot be accommodated by the insurance market in the ordinary manner. A formal agreement to this effect is being drafted, and it will be presented to Parliament next session. While the immediate intention of the Cunard Line is to proceed with the construction of one liner only, the Government agreement referred to is designed to cover a second steamer, which it is hoped may follow immediately on the one now projected. The question of the dry-docking of liners of probably about 1000ft. in length at Southampton is under consideration and is now being dealt with by the Southern Railway Company. A sum of twelve million pounds has been mentioned as a probable expenditure on the two liners contemplated, while, with the cost of dock accommodation, a further large sum may be required. So far no official announcement has been made with regard to the propelling machinery of the new liner, but on good authority we learn that our original indication that high-pressure geared turbines, with water-tube boilers, would be adopted is correct.

The Faraday Centenary.

IT was on August 29th, 1831, that Faraday, working in his laboratory at the Royal Institution, discovered the phenomenon of electro-magnetic induction. Winding two coils of wire on to opposite sides of a soft iron ring, he connected one coil to a battery and the other to a galvanometer. When he made and broke the battery circuit he observed that the galvanometer needle in the other circuit was deflected. Thereby he laid the foundations of electrical engineering. It is announced that the Royal Institution is making preparations to celebrate the centenary of this momentous experiment. It is acting in conjunction with several other bodies, notably the Institution of Electrical Engineers and the Royal Society. The Royal Society will entertain those attending the celebration. The British Association has arranged its centenary meeting, which takes place next year, to be held in London on a date coinciding with the Faraday celebrations. The Federal Council for Chemistry is to participate in a Faraday Exhibition. The programme as at present arranged will be opened by a Faraday Commemoration Meeting at the Queen's Hall on Monday, September 21st, 1931. On the following day the Institution of Electrical Engineers will hold its summer meeting and will be in joint conference with allied associations interested in Faraday's work. On Wednesday, September 23rd, a Faraday Exhibition will be opened to the public at the Albert Hall, and in the evening the opening meeting of the British Association will be held at the Central Hall, Westminster. It is the intention of the Royal Institution to mark the centenary by publishing Faraday's "Diary" in full. It is hoped that two or more of the six or eight volumes which it will occupy will be ready by September, 1931.

International Trade Conditions.

A TRADE survey just issued by the British Electrical and Allied Manufacturers' Association deals with the main factors governing international trade conditions from December, 1928, to June, 1930, and makes a tentative forecast for 1930–31. The world economic crisis, the incidence of trade depression, Empire rationalisation, and the state of production in the electrical industry, are examined in close detail, and it is shown that since the publication of the trade survey in December, 1928, important changes have taken place. Since the previous report, the Bank of England, through its own initiative and assisted by the principal joint stock banks and issuing houses, has seriously tackled the question of industrial reorganisation, and the provision of adequate capital for re-equipment. In general economic policy, many of the recommendations made from observation of the economic position ruling in 1928 have been carried out, but in electrical development the position as shown then, especially with reference to the demand for generating plant and to the state of production in electrical manufacture, has not changed very markedly. Owing to the fact that some effort is being made towards a solution of the difficulties involved, the special factors selected for attention in 1928 have ceased to be important, and an entirely new set of factors has been substituted for them of even more drastic and urgent importance, and it is the purpose of the present survey to describe such movements with a view to determining what might be expected in production and trade during 1931 and 1932. There is no doubt, the survey states, that industry and trade in this country are passing through a highly critical phase in their evolution. The depression which previously to 1930 was confined largely to this country has now become a world phenomenon and a world danger, and the greatest possible concentration of strength in industry, finance, and commerce without dissipation of forces or unnecessary internal criticism will be required to meet it.

H.M. Airship R100.

THE airship R 100 completed her voyage to Canada by arriving safely at the St. Hubert Tower near Montreal at 10.37 a.m. (B.S.T.) on Friday of last week. On the last stage of her trip, when she was following the course of the St. Lawrence, she encountered a severe storm, which delayed her progress. Additional delay was caused by damage to the fabric of the tail fins. The fabric was temporarily repaired in the air. Subsequently, at the tower, 200 square feet of fabric was replaced in a permanent manner. No engine trouble of any kind was experienced throughout the voyage, and on arrival minor replacements only were found to be required. The total distance travelled by the airship since she left Cardington at 3.45 a.m. (B.S.T.) on Tuesday, July 29th, was 3415 miles. As her flight lasted just short of seventy-nine hours, her average speed works out at about 43¼ miles an hour. Of the 34 tons of petrol with which she started she is reported to have had 5 tons remaining at the end of the trip. It may be recalled that in 1919 the British airship R 34 made her east-to-west flight from Edinburgh to Long Island, New York, in 108 hours 12 min., and just succeeded in arriving before exhausting her petrol supply.

Joints in Concrete Roads.

ONE of the most pressing problems connected with the design and construction of concrete roads is that involving the nature of the joints and jointing material between the slabs. The Ministry of Transport, in collaboration with the County Surveyor of Surrey, Mr. W. P. Robinson, is now preparing to investigate the subject on a stretch of the Chertsey Arterial Road between Kew-road and the new Richmond Bridge. The experimental section of the roadway is 480 yards long and 42ft. in width. When completed, the surface will consist of 144 slabs, each 20ft. in length and 21ft. in width and all of a thickness of 9in. The transverse joints are being made at 90 deg., 80 deg., and in some cases 75 deg. to the kerb line, and are of seven different types, namely, a plain butt joint, a butt joint with granolithic arrises, a vee joint, two forms of tongue and groove joint, a sleeper joint, and a steel dowel joint. The slabs are reinforced and are being made of 4 : 2 : 1 concrete with slow-setting Portland cement. The mixing of the concrete is being very carefully controlled, and it is allowed to mature under closely specified conditions. Test pieces are made from the material used in each slab and are examined in a temporary field laboratory established on the site. Concreting of the southern half of the road was completed on June 14th and work on the northern half was begun on June 23rd. It is intimated that other types of joints are to be tested on the new road between Hampton Court and Esher.

Improvements at Glasgow Harbour.

AT a meeting of the Clyde Navigation Trustees, which was held on Tuesday last, August 5th, it was decided to put in hand several improvements relating to the coal and cargo-handling equipment at Glasgow Harbour. At the Prince's Dock a new 40-ton movable electric coaling crane by Sir William Arrol and Co., Ltd., will be installed on the south quay, while at the Kingston Dock and at the Customs House quay six 5-ton semi-portal cranes, by George Russell and Co., Ltd., will be erected. Further progress will also be made on the electrical equipment of the Shieldhall No. I. Dock, which work is to be carried out by Johnson and Phillips, Ltd. For assisting diving operations the Renfrew works of the Clyde Navigation Trust will construct a 38ft. self-propelled boat, which will be fitted with a 2-ton crane. The Glasgow Corporation is proceeding with the scheme for the erection of a cross-river bridge at Finnieston, and in this connection a sub-committee of the Corporation has recommended the appointment of Sir Henry Maybury as an expert adviser in connection with the Finnieston Bridge scheme.

Trials of H.M.S. Dorsetshire.

SUCCESSFUL trials have been recently carried out by H.M.S. "Dorsetshire," and she is now being prepared for commission. She is the eleventh and last of the 10,000-ton cruisers laid down for the Royal Navy since the Washington Conference, and the second to be completed of the Class "A" cruisers ordered under the 1926 programme. The "Dorsetshire" was built by H.M. Dockyard at Portsmouth, and was launched on January 28th, 1929. All the turbine propelling machinery and boilers were constructed and installed by Cammell Laird and Co., Ltd., of Birkenhead. The steam trials, which were carried out in the English Channel, comprised a preliminary trial, during which the turbines worked for one hour at the full designed output of 80,000 S.H.P., a twenty-four-hour steam and fuel consumption trial at 48,000 and 64,000 S.H.P., and an eight-hours full power and consumption trial, in addition to which there were the usual steering, starting and stopping and astern tests. Throughout the whole of the trials the main and auxiliary machinery, we are given to understand, worked satisfactorily and fulfilled the requirements of the Admiralty in all respects. The principal dimensions of the "Dorsetshire" are:—Extreme length, 633ft.; breadth, 66ft.; and depth, 17ft.; with a standard displacement of 10,000 tons, and a shaft horse-power of 80,000. The oil fuel capacity of the ship is 3200 tons, and her speed 32¼ knots. Her complement is 685. Her armament includes eight 8in. turret guns, four 4in. anti-aircraft guns, and eight torpedo tubes arranged in quadruple mountings, and is generally similar to that of the earlier "County" ships.

Accidents in Industry.

THE report of the Chief Inspector of Factories, which has just been issued, contains valuable information concerning the occurrence of accidents in various branches of industry and the means which are being taken to prevent them. The number of accidents actually reported in the period under review has increased from 154,319 to 161,269, while fatal accidents rose from 953 to 982. Of these fatal accidents, 133 were connected with the building trade, 138 with the metal industry, including such trades as smelting, conversion, rolling and founding, &c., while 95 occurred in shipyards and 90 at the docks. As in previous years about 20 per cent. were caused by moving machinery, the remaining 80 per cent. being due to causes which for the most part cannot be prevented by physical safeguards. Many accidents, some of them fatal, were followed by sepsis, and the report suggests that the use of first-aid appliances, now compulsory in every factory, is still neglected. Some good work has been done by safety committees in the iron and steel industry, and the new work of drawing attention to the subject of "Safety in Industry" by means of lectures has proved of interest and use in many works and technical colleges. Over one hundred lectures have been given by the inspectors of factories, and some 16,000 persons have attended. In discussing the high incidence of accidents in the building trades, the report suggests that many of them would not occur if a little more thought, a little less carelessness and a little less callousness to danger were to be shown.

The Madsen Gun.

THE Bisley correspondent of the *Daily Telegraph* is responsible this week for a story concerning "an amazingly efficient machine gun, the invention of a Dane," with which he says the British military authorities became acquainted in 1916 at a time when the war seemed to be going none too well for the Allies. A sample of the weapon, he states, reached France. It created such a good impression that an order was given to the manufacturers at Copenhagen for a thousand as a first consignment. The guns were duly made, but German spies heard of them, and on the day before they were to be shipped an official of the German Embassy called on the Danish Foreign Minister and warned him that if the ship sailed for England, Germany would declare war on Denmark the next day. The guns were not dispatched. Subsequently, the correspondent continues, it was proposed to make the guns in this country, but the factory erected for the purpose had to be turned over to the manufacture of aero-engines, for which the need at the moment was deemed greater. The correspondent saw a demonstration of the gun at Bisley on Wednesday of this week. It weighs 16½ lb., and is distinguished by the fact that the barrel and breech can be removed and a fresh barrel and breech inserted in 10 seconds. Three spares are carried, and the barrels are changed at regular intervals. The correspondent's story is entertaining, but it is somewhat difficult to square its details with the fact that a fully illustrated account of the Madsen gun was, by permission of the Press Censor, published in our issue of March 10th, 1916. That article was reprinted in its entirety in our issue of June 14th, 1918, at a time when questions concerning the gun were being asked in Parliament. In the same issue we published a letter from a correspondent who stated that the gun was not new and that he had been engaged in its manufacture when in the employment of the Rexer Arms Company some twelve years previously.

The Unemployment Situation.

THE Ministry of Labour's weekly returns continue to reveal an increase in the number of persons unemployed. The latest figures show that on July 28th the total number of persons on the registers of employment exchanges was 2,011,467, indicating an increase of 38,737 during the week and of 857,338 during the year. A total of 2,000,000 unemployed has not been registered since January, 1922. In June, 1921, when the trade slump was aggravated by the effects of the national stoppage in the coal-mining industry, the unemployment figure reached the record total of 2,580,429. Even in 1926, following the general strike and the coal stoppage of that year, the figure did not reach its present magnitude, the highest number registered during that year being, in July, 1,645,070.

The Protection of Alternating Current Generators.

No. I.

WHILE modern alternating current generators rarely give rise to trouble as the result of faults, it is nevertheless considered desirable to provide them with some sort of protective gear which will avoid excessive damage and minimise the time and expense involved in carrying out repairs. In the past, attempts were made to design apparatus that would detect faults in the incipient stage, but owing to the difficulty of maintaining stability on heavy overloads or on the occurrence of faults external to the machine, they did not prove successful and it is now customary to let the fault develop before the protective gear operates. If the machine is then quickly isolated from the bus-bars and at the same time the field is suppressed, the resultant damage is little, if any, more than would have resulted had the fault been dealt with in the incipient stage, and the protective gear can be made safe and reliable. As far as possible,

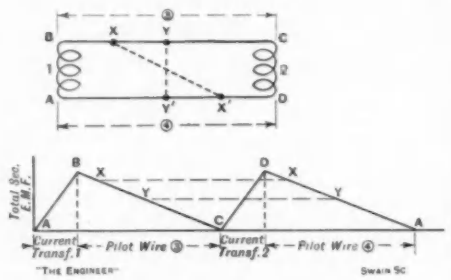


FIG. 1—DISTRIBUTION OF E.M.F.'S

the protective gear must minimise the resultant damage to the machine in which the fault has developed, prevent serious disturbance to the supply system when other generators are running in parallel with the faulty machine, and, except when the fault is on the station bus-bars, keep healthy generators in service on the rest of the system. When generator faults occur the protective gear must operate quickly and with absolute certainty, but must not operate on the largest possible over-current capable of being supplied to feed short circuits on the feeder systems. Those conditions can be met by protective gear operating on the differential principle which forms the basis of all modern generator protection. Experience shows that adequate protection is afforded if the protective gear operates on faults between phases and between a phase and earth. Faults between conductors of a given phase are difficult to deal with, but as such faults usually quickly develop into earth faults, they do not call for special treatment. Similarly, in the unlikely event of an open circuit in a stator winding owing to the burning which would accompany the arc at the point of rupture, an earth fault would result. Besides faults directly involving the stator winding, a turbo-generator is subject to other troubles, such as failure of the field, failure of prime mover, faulty synchronising and fire risk from a variety of causes. Opinions differ as to the amount of protection necessary in such cases, and the following recommendations are those of Messrs. T. W. Ross and M. Kaufmann, of the Metropolitan-Vickers Electrical Company.

Failure of the field current is an extremely uncommon occurrence, and it is the exception rather than the rule to provide protective gear to deal with trouble of that nature. If the field circuit of a generator running in parallel with others is inadvertently interrupted, the machine will continue to run as an induction generator and will derive its excitation from the other generators. The excitation current is, of course, wattless, and if there is sufficient fully excited generating plant running to supply this excitation current there will be little disturbance on the system. But if the running plant is insufficient to maintain the normal voltage, some disturbance on the system is unavoidable, irrespective of whether the unexcited machine is isolated or not. As no damage is done to the faulty machine, even if it is allowed to remain on the system, and as it does not greatly increase the liability of disturbance, the use of protective gear to guard against the loss of field current is not essential.

The next trouble to be considered is the possibility of a failure of the prime mover. For disconnecting the generator from the bus-bars under these conditions, a reverse power relay is frequently used, but it is not recommended by the Metropolitan-Vickers Electrical Company, for owing to the small amount of power which a turbo-generator draws from the system in order to run as a motor, the setting of the relay must be less than 5 per cent. of the normal full load of the machine, with the result that surging between the latter and the synchronous plant on the system owing to feeder faults is liable to cause the reverse power relay to operate and so disconnect the generator from the system. Faults on prime movers are usually accompanied by noise and vibration, which warn the attendant that trouble is developing, with the result that manual means of isolating the set may be successfully employed. An emergency hand-tripping device, such as a push-button switch, enclosed in a suitable case, can be arranged to trip both the oil circuit breaker and the emergency tripping gear on the prime mover.

When synchronising a generator, mistakes on the part of the operator may cause an interruption of the supply, and there are two schemes for preventing such interruptions. One involves the use of synchronising relays, which prevent the closing of the oil circuit breaker until the incoming machine is in exact synchronism with those already at work, whilst the other calls for instantaneous over current relays which reopen the machine circuit breaker in the event of the closing operation being wrongly timed. The first method is restricted to cases in which the oil circuit breakers are of the electrically operated type, but the system has the advantage that the windings of the machine are not subject to the stress resulting from the difference in phase. The synchronising relay made by the Metropolitan-Vickers Electrical Company relieves the operator of all responsibility for correct synchronising, as it is impossible for him to close the machine circuit breaker except under the correct conditions. The second method, however, does not prevent the operator closing the switch when the machine is out of phase, but in the event of this occurring the switch is immediately reopened before any serious disturbance can occur. The setting of the over-current relay can be comparatively low, and about 25 per cent. of the normal full load of the machine is the setting usually recommended. In the event of a "bad shot," the magnitude of the current which will flow into the machine will usually be considerable, making the operation of the relay certain and definite. When the synchronising operation has been completed, the relay is made ineffective by means of a switch in series with the tripping contacts.

When generators are of the enclosed type the risk of damage by fire is greatest, because if an arc occurs it is rapidly fanned into a flame by the draught in the ventilating ducts. Hence it is imperative instantly to disconnect a faulty generator from the bus-bars and at the same time to disconnect the field, for, otherwise, the fire may do considerable damage to the windings and the stator iron. As a further means of minimising damage by fire, it is recommended that the generator ventilating system should be of the closed air circuit type, which not only provides efficient cooling, but offers the advantage that the supply of oxygen available for maintaining the fire is strictly limited. When the ventilating system is of the open type, air dampers can be fitted and arranged to be automatically closed when the differential protective system operates, thereby preventing access of air to the machine at the time of the fault. As an alternative to air dampers, a system of fire extinguishing apparatus has been used to some extent in Europe and America.

Although some years have elapsed since the circulating current or Merz-Price system of protecting generators against fault on stator windings was first developed it still holds, by reason of its simplicity and reliability, a high position amongst generator protective systems. The type of relay employed by the Metropolitan-Vickers Electrical Company is claimed

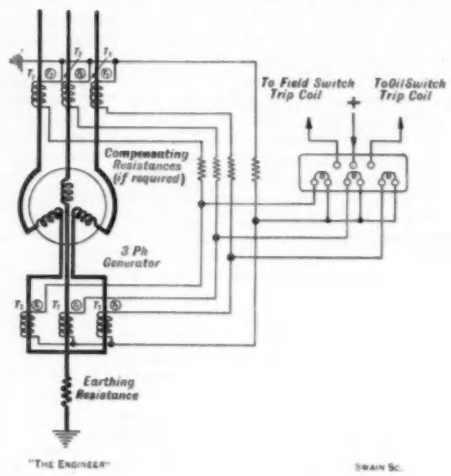


FIG. 4—PROTECTION FOR 3-PHASE GENERATOR

to give the best possible results when used with this system of protection, the outstanding features of which are quickness of operation, discrimination and reliability of operation. Quickness of action ensures isolation of the apparatus immediately a fault occurs and before there is time for it to cause serious damage to the protected machine or apparatus, and it also avoids the possibility of other machines overloading themselves and so endangering the supply system by feeding into the fault. When considering protective apparatus, a matter of importance is the minimum earth current required to operate the relays. When the neutral point of the system is connected to earth through a resistance, the latter will limit the current which can pass to earth, and if an earth fault develops on the stator winding close to the neutral point, where the potential to earth is, of course, low, the limiting of the fault current by the earthing resistance may result in insufficient out-of-balance current to operate the relay. Experience has led to the conclusion that, when applied to a three-phase generator, the protective gear should be capable of protecting at least 85 per cent. of the stator windings against faults to earth, and it is recommended that the earthing resistance be designed so that it limits the earth fault current to a value equivalent to the full-load current of the machine. If, then, the relays are set to operate with an out-of-balance corresponding to 15 per cent. of the normal load, an earth fault on a phase winding at any point having a potential above earth not less than 15 per cent. of the phase voltage will result in sufficient current passing to cause the necessary unbalance for the operation of the relay. The incidence of such points is, of course, distributed over 85 per cent. of the phase winding, and that is the amount protected when the relay setting and earthing resist-

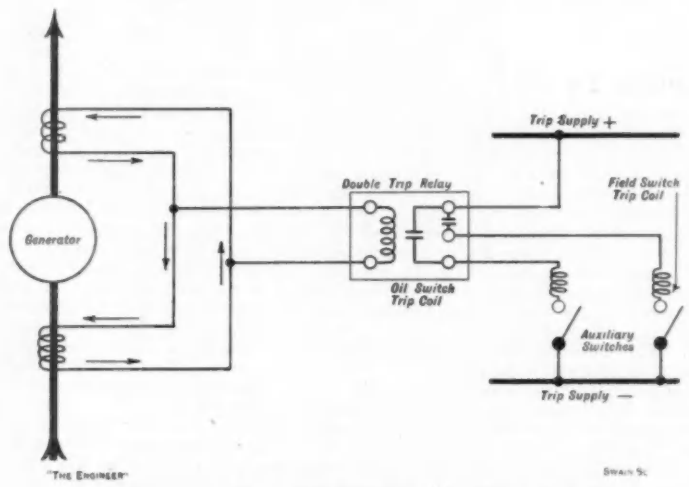


FIG. 2—PROTECTION FOR SINGLE-PHASE GENERATOR

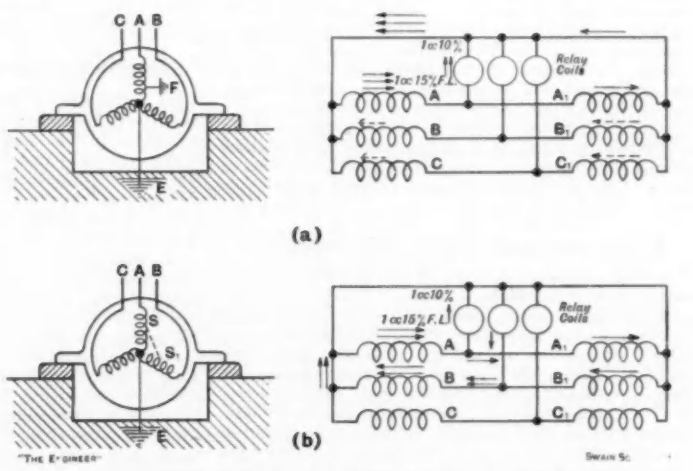


FIG. 3—PATHS SHUNTING RELAY FOR TWO FAULT CONDITIONS

ance are as described. A greater amount of the winding would be protected by adopting a setting lower than 15 per cent., but long experience has shown that this value strikes the correct balance between the maximum amount of protection and stability under all conditions of faults external to the protected machine.

If the system neutral is directly earthed without the use of a resistance, the fault current is only limited by the impedance of the faulty generator, earth plates and connections, and much higher relay settings are then permissible. That is also the case when the neutral is insulated, since no current passes to earth when the machine windings break down to the frame unless faults to frame occur simultaneously on two separate phases. In the latter case the condition is, of course, analogous to a short circuit between phases, and in that case, as in the case of a direct short circuit between phases, the fault current is not limited by any resistance other than the very small inherent circuit resistance, and always produces a substantial unbalance for relay operation even when the fault is in the immediate neighbourhood of the neutral point.

The fundamental principle of the circulating current system of protection is that, under healthy conditions, the current entering at one end of the windings of a piece of apparatus is identical in magnitude and phase with that leaving at the other. But if the apparatus be faulty, this condition no longer obtains, and use is made of the resulting inequality of the entering and leaving currents to operate the protective relay. The principle is applied in practice through the medium of current transformers which are manufactured with a view to similarity of characteristics and ratio, and one transformer is interposed at each end of each phase to be protected. Under normal conditions the current is similar in magnitude and phase in each pair associated with a particular phase. The secondary windings are connected together by means of pilot wires, the connections being such that the resultant secondary current circulates round two windings, the whole of the secondary E.M.F. of both transformers being utilised in overcoming the combined impedance of the transformers and pilot wires. This will be clear from Fig. 1, where A B and C D represent the E.M.F.'s at the secondary terminals of the transformers and are equal in magnitude. B C and D A similarly represent the potential differences in the two pilot wires, and it will be perceived that, under the conditions outlined, there is an infinite number of corresponding points on each pilot wire, such as X X^1 and Y Y^1, which are at the same potential and, consequently, no current will flow in any connection or apparatus joined to two such points; it will also be clear that the pilot wires constitute a definite burden on the current transformers, and as long as there is no other connection such as X X^1 or Y Y^1 it is equally shared by the two transformers. But, in practice, the relay constitutes such a connection and its position affects the distribution of the burden; that is to say, if the relay is not connected to two points of exactly equal potential, the burden imposed by the pilot wires is not shared equally by the transformers, for, owing to the inequality of the potentials, a small current passes through the relay and modifies the E.M.F. of the circuit by tending to equalise the potentials of the points at which it is connected. As a result the E.M.F. of the current transformer nearest the relay is automatically reduced, whilst that of the other is increased, and, since the current is the same for both transformers, that having the smaller E.M.F. will, of course, have the smaller volt-ampère burden. Although at normal generator loads the relay current is negligible, during times of heavy through faults, when large fault currents are passing through both transformers to a point outside the protected machine, it may be sufficient to operate the relay and, furthermore, the heavier burden imposed by the pilot wires on the more distant transformer may cause the latter to reach magnetic saturation before the more lightly loaded one, owing to the greater induction in the core necessitated by the higher E.M.F. As a result the similarity of voltage and phase angle characteristics is not maintained, and that may cause sufficient out-of-balance current to operate the relay. Hence it is necessary approximately to equalise the pilot resistance on either side of the relay.

It is seldom convenient to connect to the physical mid point of the pilot run, and it is more usual to connect the relay at any convenient point and to insert compensating resistance in the shorter length to bring its resistance up to that of the longer length. Small differences in length may be neglected, but there is no clear line dividing cases in which compensating resistance may be dispensed with from those in which their inclusion is essential. A rough general rule is that it is unsafe to neglect differences in all cases in which the burden imposed by the pilot leads, when carrying currents proportional to the maximum initial through short-circuit current capable of being supplied by the machine, is sufficient to cause saturation of either or both current transformers.

The necessary out-of-balance current for operating the relay is not only dependent on the arithmetic difference in current in the two current transformers; in fact, it is more correctly expressed as the vector sum of the two currents, since the reversal of one current relative to the other results in the addition of the two currents through the relay coil, and even a slight difference in phase between the currents is inimical to perfect balance. The system will therefore operate in the event of a fault on a single machine when the fault current appears in one current transformer only of an associated pair, and also in the event of a fault on a machine operating in parallel with others, in which case fault current appears in both transformers, one being reversed in polarity relative to the other.

The circulating current system applied to a single-phase generator is shown in Fig. 2, whilst Fig. 4 shows the more common application to a three-phase machine. In the latter case each set of three-current transformers is connected in a star group, and the two neutral points and the corresponding legs of the two star groups are connected together by means of a four-core pilot cable. The compensating or pilot resistances are shown connected to the shorter run between the current transformers and the relay tapping points. It will be noted that the relay coils are connected in star, and that the neutral point is connected to the current transformer common neutral while the outer three ends are connected to the three pilot wires. If the connections to the various current transformers have been made with due regard to polarity, the relays are normally inoperative. The following example of the data necessary to design a suitable circulating current protective equipment for a three-phase, 6600-volt, 0·8 power factor, 10,000-kilowatt turbo-alternator illustrates the considerations which affect the problem.

Full load current

$$\frac{10{,}000 \times 1{,}000}{6{,}600 \times 1{\cdot}73 \times 0{\cdot}8} = 1{,}100 \text{ ampères.}$$

Ratio of current transformers = 1100/5.
Number of current transformers = 6.
Percentage of windings to be protected, 85 per cent.
Corresponding relay setting, 15 per cent.

Value of earthing resistance to pass 15 per cent. full load with 15 per cent. phase voltage, *i.e.*, full load with phase to neutral voltage

$$= \frac{6600}{1{\cdot}73 \times 1100} = 3{\cdot}46 \text{ ohms.}$$

Although the relay operates with 15 per cent. out-of-balance, the actual current setting of the relay would be 0·5 ampères, *i.e.*, 10 per cent. of the secondary current corresponding to full load, the discrepancy between this value of 10 per cent. and the 15 per cent. fault setting value being accountable for by the fact that in the majority of fault conditions there are several alternative paths for the out-of-balance current, and the relay and transformer circuit. These alternative paths are provided by the transformer secondaries in the healthy phases, which, though not contributing any E.M.F. to pass the required out-of-balance current through the relay, are, nevertheless, connected to the relay and are in effect merely shunts across it. The alternative paths shunting the relay for two different fault conditions are shown in Fig. 3. In both cases the resultant shunting effect is approximately equivalent to that of one current transformer secondary across each relay. The generators are assumed to be carrying no load, but the shunting effect of the transformers is not appreciably affected by the addition of normal load current.

The advantages of a high impedance relay, such as the "F" type relay, made by the Metropolitan-Vickers Electrical Company, will be clear from the following considerations. The initial current surge when a generator is subjected to a feeder short circuit, may reach a value equal to many times the normal full-load current of the machine, since the current at the inception of the fault is only limited by the impedance of the feeder and the internal reactance of the generator. However carefully the protective transformers may be designed and manufactured, the passage of such current through these transformers may possibly produce slight differences in the characteristics as regards magnitude or phase of the secondary E.M.Fs. of the various transformers, and these differences would result in an unbalance of the system, causing a current to flow in the relay and in the various alternative paths shunting it, as shown in Fig. 3. The current will, of course, divide in the inverse ratio of the impedances of the various paths, and if the relay impedance is high in comparison with that of the alternative paths, the current will be small in comparison. These parallel paths will naturally affect the relay setting for normal operation on a faulty machine, and allowance must be made for this in determining the maximum fault current for operation.

(To be continued.)

Rand Water Board—Annual Report.

A COPY of the twenty-fifth Annual Report of the Rand Water Board to the Minister of Public Health of the Union of South Africa reached us recently. It contains much of interest, as have all its forerunners. It deals with the financial year ended March 31st last, and it comprises, first of all, a general Report which is signed by Mr. J. H. Stevenson, Secretary and Treasurer to the Board, which is followed by balance sheets and various statements of accounts. Then comes the Report of the Auditors, and, finally, there is the Report of the Chief Engineer, Mr. C. E. Mason, M.I.E.E., M.I. Mech. E.

From the first document we learn that the minor works necessary to complete Portion "B" of the Second Unit of the Vaal River Scheme, which were referred to in the last Report as being still in progress, were completed during the year under consideration, and that in January last it was reported to the Board that the final cost of "Portion 'B' of the Second Unit" amounted to £156,225, or £4017 less than the estimate. During the year, the demands of the Board's consumers necessitated the sources of the Board's supply being drawn upon to the extent of an average daily supply of 16·14 million gallons, of which 9·74 million gallons were pumped from the Vaal River reservoir, while the balance was taken from the underground supplies of the Klip River Valley. The sale of water during the year averaged 15·54 million gallons a day, which represented an increase of 0·37 million gallons over the highest average daily quantity previously recorded, namely, 15·17 million gallons a day for the year ended March 31st, 1929. The daily consumption during the year varied between a maximum of 20·16 million gallons on November 8th, 1929, and a minimum of 11·15 million gallons on February 16th, 1930. The particulars of water consumptions during the past nine years are of interest:—

Period, year ended March 31st.	Average daily quantity supplied to all consumers. Million gallons.	Variation in daily consumption.	
		Maximum. Million gallons.	Minimum. Million gallons.
1922	10·88	13·69	8·40
1923	11·37	13·42	9·15
1924	12·02	16·09	8·50
1925	12·19	14·77	10·00
1926	12·60	16·76	9·23
1927	13·69	17·73	9·06
1928	14·82	17·92	10·36
1929	15·17	20·38	10·58
1930	15·54	20·16	11·15

The Board is debarred by its Statutes from making any profit out of the sale of water. The Statutes provide that the Board shall charge for water supplied by it to all its consumers at a *uniform* rate sufficient to meet the working costs incidental to the undertaking. For eighteen months prior to October 1st, 1928, the uniform charge stood at 7½d. per 1000 gallons. The increasing demands for water, together with economies effected in the working costs, enabled the Board, first of all, to reduce the uniform charge to 7d. and then, at the beginning of the period covered by this Report, to 6½d. per 1000 gallons.

In addition to the *uniform* rate, the Board is empowered to make *special* charges for water supplied to the gold-producing mines and to consumers other than the municipalities, the gold-producing mines and the Railway Administration. The *special* rates in force during the year under review were as follows:

	Per 1000 galls.
(*a*) Gold-producing mines	6½d.
(*b*) Consumers other than the municipalities, gold-producing mines and the Railway Administration	23½d.

From the Chief Engineer's Report we learn that the estimated population supplied with water comprised 291,930 Europeans and 392,032 non-Europeans, or a total of 683,962. The quantity of water available was 10·600 million gallons a day from the Vaal River and 10·0 million gallons from Zwartkopjes and Zuurbekom. The total quantity of water sold during the year was 5,674,088,295 gallons, as compared with 5,539,589,601 gallons during the preceding year, an increase of 134,498,694 gallons, although the rainfall during the year was the highest recorded for five years and the number of days on which rain fell was above the average. On the other hand, the ore milled by the mining industry increased by 198,000 tons as compared with the previous year. The actual volume of water pumped from all sources was 5,891,400,000 gallons, or 217,311,705 gallons more than were sold. Of that quantity, 105,969,100 were used on the works and 216,000 were due to "decrease in reservoirs," which leaves 111,558,605 unaccounted for, including losses due to leakage, evaporation, scouring mains, cleaning reservoirs, &c. The losses due to leakage, &c., formed 1·894 per cent. of the total water pumped, and was the second lowest figure that had been experienced since the Board began to operate, the only lower figure being 1·431 in the year 1927–28.

The Board had in service during the year 285 miles of pipe lines, made up of 261 miles of pumping and gravitation mains, and 24 miles of collecting mains from bore-holes and wells to main stations. The greater portion of these mains are of welded steel pipes, but recently reinforced concrete pipes, manufactured locally, have been laid and are giving satisfactory service. The largest sized pipes in use have an internal diameter of 36in.

The water supplied by the Board is constantly examined chemically and bacteriologically at all sources of supply, and storage reservoirs, as well as at numerous points on the reticulation system. One hundred and sixty-six chemical analyses and 414 bacteriological examinations were made during the year. The quality of the water throughout the year is descriebd as having been of a consistently high standard.

The rainfall throughout the area covered by the

Board's operations was in excess of the average and was distributed over the Witwatersrand, as is shown in the following table :—

	Average for 26 years.	Rainfall, 1929–30.
Eastern section ..	28·89 ..	36·21, or 25·34% above average
Central section ..	30·47 ..	34·92, or 14·60% above average
Western section..	28·44 ..	34·56, or 21·52% above average
Southern sect'n ..	27·86 ..	35·04, or 25·77% above average

As is well known, the region is particularly subject to thunderstorms, some of which are of a very violent character. As a precautionary measure against damage by lightning striking the overhead transmission lines, the electrical plant and machinery at the Zwartkopjes and Zuurbekom Pumping Stations were shut down during thunderstorms. In consequence of these electrical disturbances the Zuurbekom plant was shut down on thirty-four occasions for a total period of 110 hours. In spite of that, however, the cost of the damage done to the plant amounted to £105 8s. 3d. The Zwartkopjes bore-hole transmission lines were shut down on ninety-nine occasions for a total period of 268 hours, and the cost of the damage done amounted to £28 11s. Actually, damage was only done to the Zwartkopjes plant on four of the ninety-nine occasions on which it was found necessary to shut down, while of the thirty-four times on which the Zuurbekom line was shut down damage was caused on fourteen occasions.

We have before had occasion to remark on the fact that the Rand Water Board is exceptionally fortunate in that it is able to obtain its coal very cheaply, as compared with this country at any rate. The total quantity of coal which was delivered to its various pumping stations during the year was 80,653 tons, and the cost of the fuel delivered at the railway stations and sidings serving those stations was £24,911. Actually, 2264 tons more were delivered than during the year before, though the cost was £89 less. The average price paid for the coal throughout the year was 6s. 2·12d., as compared with 6s. 4·54d. The decrease of 2·42d. per ton was due to the lower average evaporative duty of the coal delivered during the year under review, as compared with the year before. The total cost as delivered at the station coal bunkers was £26,860, as compared with £26,825 for the previous year, or an average of 6s. 7·92d. as compared with 6s. 10·12d.—a decrease of 2·2d. per ton. The amounts of fuel delivered at the different stations in the years 1928–29 and 1929–30 respectively are shown in the following table :—

Station.	Year ended March 31st. 1929. Tons.	1930. Tons.	Increase or decrease, tons.
Zwartkopjes	56,675 ..	61,926 ..	+5,251
Zuurbekom	750 ..	236 ..	— 514
Paarlshoop	251 ..	— ..	— 251
Village Main	2,135 ..	— ..	—2,135
Vereeniging	18,389 ..	18,491 ..	— 87

The steam plant at the Village Main pumping station was shut down in January, 1929, and the Paarlshoop station was converted from steam to electrical operation during the last financial year.

The cost—pumping only—of water per 1000 gallons raised 100ft. worked out at an average of 0·1759d., as compared with 0·1900d. for the year before, or a decrease of 0·0141d., which represented a total difference of £7848. Actually, 107 million gallons more water was pumped than in the preceding year, but the pumping costs were reduced by the amount stated. The total cost of pumping during the year under review amounted to £58,246, which was the lowest figure since the year 1919, when the amount was £57,541, but during 1929–30 the quantity of water sold was 1857 million gallons more than during that year. The total cost per 1000 gallons, based on the quantity of water sold was 6·352d., as compared with 7·088d. for the previous year—a reduction of 0·736d. This reduction, it is explained, was largely attributable to the economies in working costs which have resulted from the scheme for pumping direct from the Zwartkopjes station into the Johannesburg Municipality's high service reservoir at Yeoville, which was brought into operation towards the close of the year ended March 31st, 1929, and was described in the last Report.

In that Report, too, reference was made to the agreement which had been arrived at between the Board and the Rand Mines Power Supply Company, Ltd., regarding the water from the Barrage Storage area to be used by the Company for cooling purposes in its extended power station. In view of this agreement, and as the Power Company was proceeding with its extensions, the protective works considered necessary by the Board for the safeguarding of its interests on account of the detrimental effect which, under certain conditions the extension of the generating station would have on the quality of the water abstracted from the Vaal River, were immediately put in hand. They consist, as a preliminary measure, of pre-sedimentation tanks and water-cooling and aerating sprays. The pre-sedimentation tank system consists of twelve hopper bottom tanks, each 40ft. square in plan, and 38ft. deep, with a total capacity of 2,000,000 gallons. The tanks are arranged in series of six on each side of a centre tunnel. The water is introduced through two overhead open flumes each feeding six tanks, being admitted to each by a specially designed inlet valve. The valves for the control of the scour pipes are arranged in the centre tunnel, where provision has been made for easy access and for cleaning. High-pressure water can be introduced at any point for back scouring and for breaking up accumulations of sludge. The cooling and aerating sprays are arranged in parallel over the basins and are brought into service when required by a by-pass valve. The settled water is drawn off over a sharp-edged weir along the whole of the perimeter of each tank. It is then measured and discharged into a common central flume prior to entering the existing sedimentation tanks.

By the terms of the agreement, the Board was authorised to construct such works as it considered necessary to protect its interests, as explained above, and in order to enable it to do so free of cost to it, as well as to maintain such additional works, the sum of £3600 per annum is payable by the Company to the Board for a period of thirty years beginning April 3rd, 1929.

These works were nearing completion at the date of the Report, and it was anticipated that they would be available for service before this month—August. Their estimated cost is given as being £19,500.

The Zwartkopjes station operated throughout the year under the altered conditions of pumping direct to the Yeoville Reservoir, the arrangements for which were completed during 1929 under Portion "B" of the Vaal River Scheme, which were fully described in previous Reports.

At the Vereeniging pumping station a 600-kW turbo-generator, by Brown, Boveri & Cie., of Baden, was installed and put into satisfactory operation.

The reorganisation of the Village Pumping Station, carried out in conjunction with Portion "B," was completed. The electrically-driven pumping machinery installed there serves as a stand-by plant in case of breakdown of the pumping plant at Zwartkopjes, but during the year under review it was not necessary to use it for that purpose. Apart from this stand-by plant, the whole of the Board's distribution offices, workshops, and stores have now been centralised at that station.

At the Paarlshoop pumping station the plant is only operated during periods of high demand. The electrification of this station has, it is stated, greatly facilitated the distribution of water in that area.

With the completion of Portion "B" of the Vaal River Scheme, the Board has now available 10 million gallons of water per day raised from the Vaal River. That is half the quantity which can be abstracted from the reservoir formed by the barrage constructed across the River, so that a further 10 million gallons is available for future developments.

The total discharge of the Vaal River at the Barrage during the year was 829,330 million gallons. That quantity would have been sufficient to fill the reservoir sixty-one times, the capacity of the reservoir being 13,633 million gallons. The largest flood recorded during the year took place on December 5th, 1929, when 54,000 million gallons of water passed the Barrage during the twenty-four hours. The rainfall recorded for the year at the Barrage was 36·6in., or 13·58in. more than in the previous year.

A Newsprint Mill in Nova Scotia.

TOWARDS the end of 1929 the Mersey Paper Company's huge newsprint plant at Brooklyn, in the province of Nova Scotia, was officially put into operation with an initial production of 250 tons of newsprint daily. It is one of the most modern plants on the continent, and represents the first complete paper-making unit in Nova Scotia. More than 17,000,000 dollars have been spent in bringing this enterprise to a production basis. The plant is interesting in its wide application of water transportation and power to the problems of the paper industry. The two initial paper machines in this mill are each 234in. wide and are designed to run at a speed of 1200ft. per minute with a capacity of 125 tons of paper per day each.

The mill has been appropriately built at the mouth of the largest river in the province, the Mersey. It is thus situated in a sector which is convenient to timber lands having coniferous growth, wherefrom pulp wood can be delivered at low cost and in proper quantities to the mill. It is also situated within the largest watershed in the province, from the drainage area of which a large source of power is available at close distance. Further, the property on which the mill has been built is on tide water, and presents a desirable feature for the shipping of the finished product. The geological formation of the site is composed almost entirely of solid rock, so that good foundations for the extensive mill buildings and heavy machinery required in the make-up of a modern paper mill were readily obtained.

The buildings lie almost in a northerly and southerly direction. On the north, the mill property is flanked by the Canadian National Railroad, with siding and shunting facilities at the village of Brooklyn, and connecting trackage into the mill yards. On the east the property runs down to a protected arm of Liverpool Bay known as Herring Cove, which forms a convenient and suitable booming area for the storage of pulp wood. On the south is the mouth of the Mersey River, known as Liverpool Harbour, and on the west is territory along the bank of the Mersey over which the power transmission line enters the mill.

The buildings are of steel and brick fireproof construction with gypsum waterproofed roofs and continuous reinforced concrete floors. They are arranged compactly and have been designed to present a good architectural appearance. All departments are in separate buildings, and all these buildings are interconnected. At the north end of the mill is a series of low buildings which comprise the general offices, stores department, repair shop, locomotive house, roll grinder room and sub-stations. South of this group is a large four-storey building which forms the ground wood mill. To the east of the ground wood mill is the chipper department, and east of that again is the complete acid plant.

THE SULPHITE GROUP.

The highest buildings are those of the sulphite mill group. The machinery in them requires high elevation, and the buildings rise some 150ft. above ground level. Immediately to the west of the sulphite mill is another large building wherein the ground wood and sulphite processes are united before their products are conveyed to the last stage of the newsprint process in the mill. This is known as the mixing room. South of the mixing room is the largest building unit, the paper mill, which is 378ft. in length and over 119ft. in breadth. Further south are the finishing room, core room and storage room for paper to be shipped by rail. To the east of the paper mill is another series of high buildings composed of the coal tower, boiler-house, and turbine room. The above-mentioned buildings form the main group. They are all constructed of "Bluenose" Nova Scotia red brick, and are in every sense a pleasing group of industrial structures. The total distance from north to south of these buildings is some 740ft.

The shipping end of the buildings extends to the water's edge, and from there a covered passageway leads to the main wharf, which has been built on wooden piling. The covered passage and the storage building on the paper wharf are steel buildings with wooden, tar and gravel covered roofs, and galvanised metal sides. The passage to the wharf, which was necessitated because the wharf had to be in deep water to provide sufficient draught for large ships, is 780ft. long and is built on large rock-filled cribs. The main wharf is 440ft. long. Adjoining the main wharf at an angle is a smaller wharf, also constructed on piling, which is used as an unloading wharf for coal and sulphur.

WOOD PREPARING.

Wood, which will be of both the spruce and balsam fir varieties, will be delivered to the mill in 4ft. and 8ft. lengths with the bark still on. This wood will reach the mill either by rail in cars, by water in boats, by raft, or by being trucked from nearby points direct to the mill. Wood arriving in boats will be discharged into bag booms and will then be placed within the main holding boom in Herring Cove. The special equipment for storing wood in water is interesting. The mill, being on tide water, is subject at times to heavy ground swells, although the booming area is protected by a breakwater. It has therefore been the policy of the management to provide very heavy booming equipment in order that the wood will be saved from loss in storms. The Mersey booms consist of two 24in. and by 24in. square British Columbia fir native timbers bolted together side by side. These spars, which are 30ft. long, are separated by spacer blocks and have been prepared with hardwood inserts at the ends to compensate for the chafing of the boom chains. The booming area at Herring Cove has a capacity of about 4000 cords.

SLASHER MILL.

The wood from the pondage area is retained by a jack ladder. On account of the tide, the ladder is furnished with a hinged end in order that sufficient wood can be delivered to it at all times. The slasher mill is equipped with ladders for both 8ft. and 4ft. wood, the 4ft. ladder being an end-on ladder. With the 8ft. ladder wood is delivered broadside and is carried to the slasher table at a speed of 80ft. per minute, or with a capacity of 30 cords an hour. At the slasher table the logs are delivered to an alligator chain, which carries them past the cutting and trimmer saws, which are 60in. circular saws rotating with a peripheral speed of about 12,000ft. a minute. After the cutting operation the wood is delivered to a cross conveyor which takes it to the large conveyor delivering wood to the stacker and thence to the block pile. The stacker is 125ft. high and is of the movable type. The conveyor on the stacker has a capacity of 60 cords an hour and is driven by a 50 H.P. slip-ring motor. This stacker is built of a structural steel cantilevered truss frame held in position by two concrete weights, each of 120 tons. It is interesting to note that all of the conveyors, slashers and equipment in the wood preparing plant are motor-driven and are connected with the modern short-centre "Texrope" drive.

All of the wood is delivered to the storage pile in 4ft. lengths and with the bark on. This policy is followed in order to maintain a covering for the wood to keep as much dirt and foreign material as possible from being picked up and thus to prevent imperfections appearing in the final product. There is sufficient storage area for approximately 35,000 cords of wood, or slightly over one-third of the annual mill requirement at 100 per cent. capacity. Wood from

the pile is reclaimed by means of a petrol tractor crane using an orange peel grab bucket. This wood is placed in reclaiming conveyors which deliver it to the return strand of the large cable conveyor which, in turn, takes it to the barking room.

BARKING ROOM.

The present plant consists of three 10ft. diameter by 30ft. long steel barking drums. The combined capacity of these drums will vary according to the nature and condition of the wood, but, with 16 hours a day operation, sufficient wood to produce 250 tons of paper, or, roughly, about 375 cords of wood per day will be barked. These drums are driven by 100 H.P. wound-rotor motors with "Texrope" drives through spur gear reduction, so that the rotation of the drum is about 6 r.p.m. The wood is delivered to the drums by a large slow-moving conveyor, upon which are placed adjustable gates to regulate the supply. The barking operation is performed with the addition of large quantities of water, the bark being removed by the bruising action of the sticks of wood against one another. The wood gradually works through the drum and over a dam at the discharge end, and is taken by another conveyor up to the mill for use in the process.

If any bark is still left on the wood the latter is placed by operators on re-circulating conveyors and goes through the drumming process again. The drum construction is made up of special heavy steel staves held together at the circumference with steel bands. Space is provided between the staves for the bark to drop out of the drum and on to the bark conveyors. The drums are provided with tires which rotate on steel trunnions. Each drum weighs approximately 75,000 lb. The accepted wood proceeds from the drumming plant by conveyors in the conveyor bridge to the main buildings. At a transfer point it is divided for the two important intermediate processes in paper manufacture, namely, the ground wood and sulphite. Approximately 75 per cent. of the wood is used in the ground wood process, and that wood proceeds by elevated conveyors to block bins situated in a monitor over the ground wood mill. The wood required for the sulphite process is removed by an operator and sent down a chute to a conveyor on a lower level going to the chipper room.

CHIPPING ROOM.

The chipping room in this mill is provided with an 88in. chipper, revolving at a speed of 275 r.p.m., which has a capacity of about 20 cords per hour. The chips from this machine are delivered to a direct-driven chip crusher, which refines the chips, breaking up the longer cords and splinters in order that proper sizing of chips is maintained. The chips from the crusher fall by gravity down a chute to an inclined screen of the "Hummer" type, which is merely a couple of screens of different mesh placed in rapid vibration by an electro-magnetic device. The screen separates the sawdust from the chips and also takes out pieces which are too large to be acceptable. The sawdust from the chip screen is blown by means of a fan and 17in. pipe line to the boiler-house, where it is used as fuel in the waste furnace. The accepted chips are delivered to belt conveyors and thence to a bucket elevator which raises them 110ft. to bins over the digesters. The rejects from the chip screen are delivered by other belt conveyors to a re-grinding hog which breaks them up and sends them back to the screen to be reclaimed.

SULPHITE MILL.

The large quantites of digester acid required in this mill are made in a special group of buildings known as the acid plant. The sulphur, which is delivered from the sulphur storage, is transferred by a small dump car on a narrow gauge track to the burner room. There, the sulphur is elevated in a small bucket elevator to a hopper, from which it is weighed on an automatic scale and delivered to a melter with a conical bottom, in which it is melted by means of coils through which steam is circulated. The melted material is then delivered to a rotary burner in which it is burned to form sulphur dioxide gas, which is delivered to a large steel brick-lined combustion chamber, in which any free sulphur which has not been burned is ignited and form additional sulphur dioxide gas. The gas then passes into a main and is delivered to a separate room known as the cooler room. There it passes through a series of large coils made of lead piping over which cold water is continually playing. The gas is drawn through the coolers by means of a fan, entirely built of acid-resisting lead, and is then delivered to the acid towers. These towers, of which there are two, are arranged just outside the cooler room. Each tower is 94ft. high and is 8ft. in diameter. The walls are built of 9in. thickness reinforced concrete. The towers are lined with special acid-proof vitrified segment block tiles made of a shape to conform to the circumference, the tiles being cemented together by a mortar consisting of glycerine, silicate and litharge.

The gas is first delivered to the weak acid tower and passes through limestone blocks, over which water trickles downward in a constant stream. The chemical reaction which takes place forms weak acid, which is collected at the bottom of the tower and delivered by small acid-resisting high-speed pumps to the second, or strong, tower. There it combines with more SO_2 gas and forms strong digester acid, which is pumped to the storage tanks. The Mersey Paper Company has two acid storage tanks constructed of B.C. fir staves supported by heavy iron bands.

DIGESTER ROOM.

In the digester room the chips and the acid are brought together in the digesters in the making of sulphite pulp. There are three digesters, each 54ft. high by 16ft. in diameter. They comprise a steel shell, having conical ends at the top and bottom, and are built up of 1¼in. steel boiler plates. They are designed for an operating pressure of 125 lb. per square inch, although a pressure of only 70 lb. is employed. Each digester is provided with a special double acid-resisting tile lining.

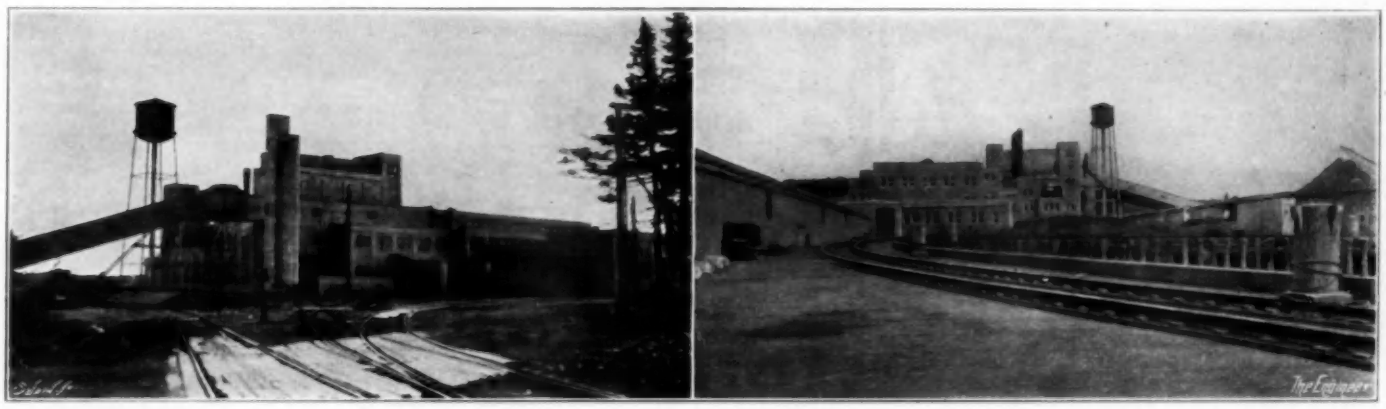
The chips for the process are delivered from the individual steel chip bins through a gate arranged over each digester. The filling of a digester requires about 30 cords of chips and approximately 30,000 gallons of acid. After filling, the digester covers are securely bolted on and the digesters are steamed under 70 lb. of working pressure.

After the "cook" is completed, the contents are blown under pressure from the bottom through large bronze blow-pipes to blow-pits in the blow-pit room. There is an individual blow-pit, measuring 30ft. in diameter by 26ft. in height, for each digester. They are constructed of wooden tank material, similar to the acid tanks. The stock from the digesters is blown against heavy target plates on the walls of the blow-pits in order to take the force of the blow and break up the stock. Across the top of the three blow-pits is a large wooden manifold, which collects the gas and vapour and delivers it to a wooden chimney or vomit stack. In the basement of the blow-pit room are two stock pumps which pump the sulphite stock, after washing and draining, to a large concrete equaliser chest, which is directly overhead. The stock in the equaliser chest is kept under continual agitation by large wooden paddle arms attached to a horizontal shaft, which is driven by a motor through a worm-gear speed reducer.

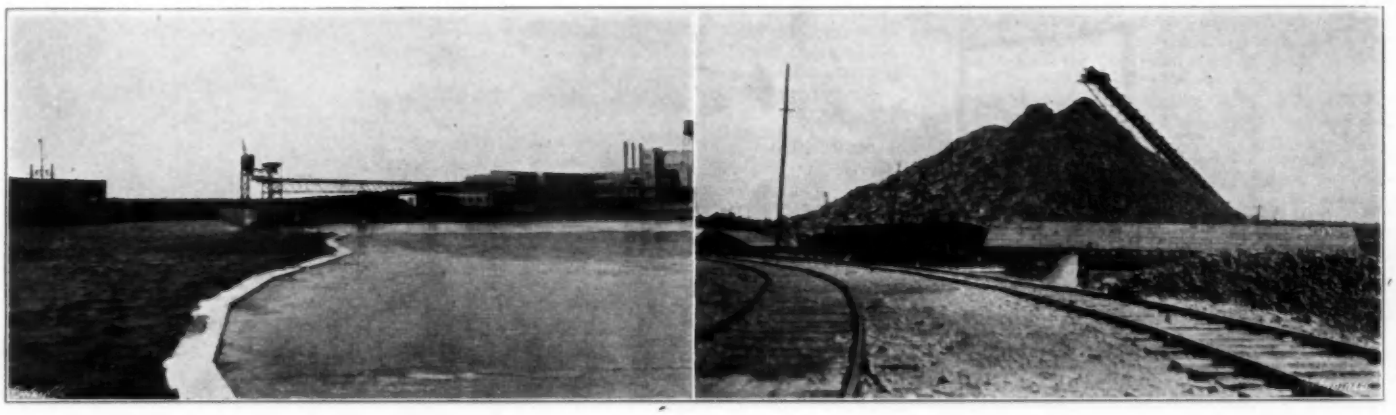
From the equaliser chest the stock flows by gravity to the sulphite knotters. There are two of these knotters, or coarse screens of the rotary type, driven in a battery by means of a "Texrope" drive. In the knotter room are also the tailing screens for both sulphite and ground wood. The stock for these latter screens consists of the rejects from the fine screens which are pumped from the mixing room. Stock from the knotter screens is delivered by gravity to the sulphite screens in the mixing room, where the final screening takes place. These screens are of the horizontal turbo-runner type and operate at a speed of 400 r.p.m. They are driven with short centre "Texrope" drives.

GRINDING ROOM.

The grinding equipment is made up of the very



GENERAL VIEWS OF THE MILL BUILDINGS



VIEW OF MILL FROM WATER FRONT — PILE OF PULPWOOD IN STOCK YARD

latest continuous magazine grinders. Wood is delivered to a continuous large wooden bin extending upwards from the charging floor of the grinder room to the top of a large monitor on the roof. This bin has a capacity of 300 cords. At the bottom of the bin, directly opposite the magazine openings, are holes in the side of the bin from which operators take the 4ft. wood and feed it to the grinders.

The grinders themselves extend from the charging floor to the operating floor beneath and are 21ft. high. There are six lines of grinders, with two grinders on each line, each driven by a direct-connected 2600 H.P., 225 r.p.m. synchronous motor. Synchronous motors are used in order that the power factor of the total mill may be maintained as near unity as possible. The grinders consist briefly of heavy main side frames which carry a set of jacks supporting the magazine above. At the lower part of each main frame is placed the heavy water-cooled main bearings which carry the 15in. grindstone shafts.

The grindstones are 54in. in width by 67in. in diameter when first placed in action. The pressure pocket or lower section of the magazine is constructed of heavy steel and iron castings and has attached to it the entire driving mechanism of chains for feeding the wood. The magazine is supported by lifting jacks which are driven through shafts and bevel gears by reversible motors, and are used to raise or lower the pocket as the stone wears away. The upper part of the magazine is merely a plate and structural steel box arrangement within which the wood is neatly placed for the grinding.

The feed chains are constructed of links with heavy steel shoes to engage the wood and force it against the stone. These chains are endless and are carried on sprockets at top and bottom. These grinder chains are driven through heavy worm drives, which receive their motive power from a special oil motor which is simply a set of herringbone gears driven by means of oil pumped through them at high pressure. There is an automatic electric wattmeter-type governor for each pair of grinders which keeps the load on the large motor driving the grinders at a constant value by controlling the speed of the oil motors driving the chains. This oil under pressure is provided by two oil pumps in the basement.

The grinders, on account of their great weight, required massive foundations. The grindstones for each machine are set in a pit which acts as a stock trough to carry away the ground wood pulp. This pulp is delivered continuously over a wooden dam placed in the trough in front of each grindstone. Each grinder is equipped with a lathe, with which the stones are trimmed as required.

The stock from the grinders is delivered through two large stock troughs to three rotary bull screens at the east end of the grinder room basement. These screens are of the "Pascol" type and are the same as the sulphite knotter screens. The stock flows in at one end of the 5ft. diameter by 12ft. long screens, which are made up of screen plates of rolled steel and are perforated with $\frac{1}{16}$in. diameter holes. These screens are rotated at about 16 r.p.m. and the stock is continually dropping through the screen while the slivers and sticks are retained and then sent to the sewer. "White water" from other parts of the process is used for showers on these screens. The ground wood stock from the screens is collected in a large concrete tank directly underneath and is then pumped from here to the fine screens. There are two ground wood stock pumps provided for this purpose.

Mixing Room.

The ground wood and sulphite processes are brought together in the mixing room. The stock, after being pumped from the bull screens in the grinder room, is delivered to the ground wood fine screens on a mezzanine floor in this building. There, four ground wood quiller screens perform the final screening operation. These screens are driven by individual "Texrope" drives and run at about 250 r.p.m. On this same mezzanine platform are the two sulphite fine screens, which are of the same type, except that they operate at a higher rate of speed and have bronze runners. The rejects from both the sulphite and ground wood fine screens drop by gravity to pumps below, which deliver them to the tailing screens of the knotter room.

The stock delivered to both the ground wood and sulphite fine screens is less than 1 per cent. consistency. In order to maintain a constant supply for the paper machine, some storage is required in the system and it is provided by means of large tanks. In order to save space, however, it is necessary to increase the consistency to about 3 per cent., and that is done in this mill by means of filters.

The stock flows from the ground wood fine screens to eight large filters, each having a capacity of from 28 to 30 tons of pulp per day. In addition to stock from the fine screens, "white water" from all sources is sent to these filters for the purpose of reclaiming the last ounce of stock before the water is wasted to the sewers. The filters are large slow-moving cylinders, 8ft. 6in. in diameter by 14ft. long, moving deeply submerged in a vat. The stock is delivered to this vat and the cylinder, upon which is wound a Fourdrinier wire, rotates in the vat picking up the stock. Around the cylinder is wound a great number of cords which carry the stock, after leaving the cylinder, round a small tension roll, and from there the stock drops from the strings and is delivered to the repulpers, which break it up and send it to stock tanks in the basement below.

The large cylinder in the filters is divided into sections, and these sections come under vacuum or under pressure according to whether they are picking up the stock or discharging it to the cords. The vacuum is maintained by means of small motor-driven vacuum pumps in the basement. As the cylinders rotate in the vat, the stock is picked up on the wire and strings in a continuous sheet, the water being drawn to the inside of the cylinder and delivered through a barometric leg to seal pits in the basement below. A vacuum of 12in. is maintained on the sections of the cylinders when it is picking up the stock. The filters used on the sulphite stock are two in number of very much larger capacity. They are constructed of wood and bronze to resist the acid in the stock. All these filters have a very high efficiency, and the "white water," which is delivered to the seal pits, contains less than 1 lb. of stock per 1000 gallons.

The ground wood stock, after being delivered at about 3 per cent. consistency to the stock tanks, is then pumped by means of pumps to a large steel storage tank outside of the building. This tank, which is 65ft. in diameter by 30ft. high, has a capacity of about 135 tons of ground wood stock. The sulphite stock is stored in a concrete stock chest in the basement below the sulphite filters. This tank is provided with an agitator.

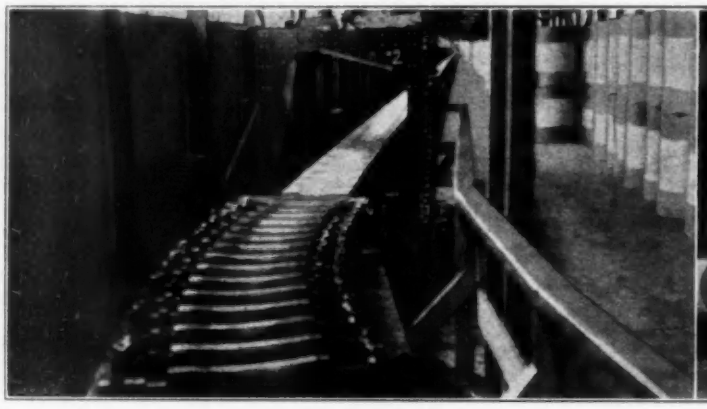
Wet Machine Room.

In the basement of the mixing room is also the wet machine room. The rejects from the tailing screens are refined in a Jordan machine and are then delivered in stock form to a wet machine. This equipment consists of a series of heavy wooden rolls, upon which is wound an endless felt. At the back of the wet machine there is a tank into which the stock is delivered. A roll picks up the stock and transfers it to the felts in a continuous sheet which passes through squeezing rolls to remove some of its water. The sheet is finally wound on a roll at the front of the machine, and the operator breaks the sheet from time to time, and forms it into a bundle. These bundles or laps are sold for use on board machines for the manufacture of heavy wrapping paper.

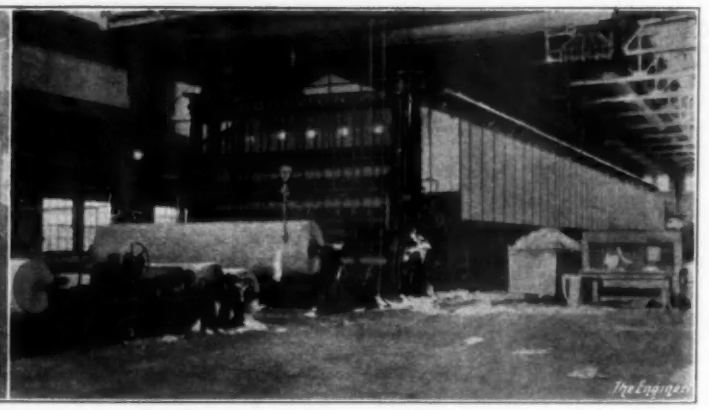
The stock from both the ground wood and sulphite storage is then pumped to a Trimbey metering, mixing and proportioning system. This operation is carried out continuously by means of pumps. Before being pumped to the Trimbey, however, the stock is again changed to about 1 per cent. consistency by means of automatic consistency regulators. The Trimbey system automatically mixes the ground wood and sulphite stocks for the paper machines in the correct proportion. It also adds colour and alum to the stock in the proper amounts in order that the finished sheet of paper shall have the shade which is demanded by the customer. This metering system is placed in the paper machine room behind the wet end of the paper machines.

The Paper Mill.

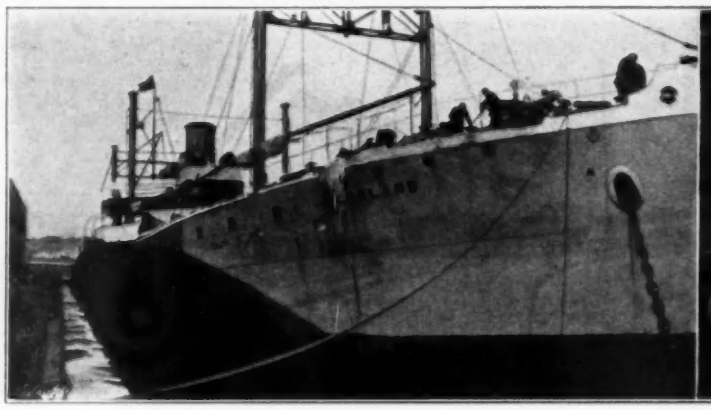
From the metering system the stock falls by gravity



Conveyor for Taking Paper Rolls to Wharf



Finishing End of a Paper Machine



The Paper Company's Steamer "Markland"

Rolls of Paper in Hold of the "Markland"

to the mixed stock chest. This chest is provided with an agitator which keeps it properly stirred up. The stock in the mixed stock chest may now be termed paper stock. From there it is pumped to a regulating stuff box on each paper machine. This consists of another meter driven by a direct-current motor, which is synchronous with the paper machine drive, and meters out the paper stock in the correct amount required by the paper machine. From the regulating box the stock drops by gravity to a high-speed fan pump, which delivers it to Bird screens before it is fed to the paper machine. There is a separate regulating box and fan pump for each of the two paper machines, and there is also a separate battery of three Bird screens for each machine. The Bird screens, which are arranged above the main floor of the paper machine room, are of the inward-flow rotary type, and are driven by means of a worm gear reduction on the cylinder.

The stock is fed to the screen through two flow boxes, into a vat, in which rotates a cylinder which is fitted with slotted plates. The vat is vibrated or shaken by means of an excentric mechanism and the pulsation assists the fibres in the stock to work through the slots. The screening which takes place in the Bird screens is the last fine screening prior to the stock being delivered to the paper machine for making the finished product. The accepted stock is discharged through the open cylinder head end direct to the head box of the paper machine in a homogenous mixture of clean fibres and water. The tailings and heavy material settle to the bottom of the vat and are drawn in a small constant stream to be circulated to an auxiliary screen nearby.

SHIPPING.

The company will ship most of its product by water. For that purpose it owns a special steamer, the "Markland," which has a capacity of 4100 tons of newsprint. In its design special attention has been given to "damage free" storage and to ease of handling of paper rolls to and from the ship. The vessel has five separate water-tight cargo holds, box-like in form, averaging about 50ft. deep. There are no obstructions in these cargo holds, and even the side frames and bulkhead stiffeners are protected to avoid contact with the paper rolls. The vessel is 338ft. long by 52ft. 6in. beam, by 30ft. moulded depth. It conforms to Lloyd's highest class and is fitted with twin triple-expansion engines, developing 2000 H.P., the steam being generated by three oil-fired Scotch boilers. This ship will deliver the product from the mill to ports on the Atlantic seaboard. It is interesting to note that the distance from Booklyn, Nova Scotia, to New York, is only 480 miles by water.

COAL HANDLING.

Mention has already been made of the coal wharf at which coal ships will be unloaded by an elevated pier crane. This crane will discharge cargoes at a rate of 75 tons an hour by means of a clamshell bucket, delivering the coal to a hopper at the end of the coal bridge. On the coal bridge an electric trolley operates at high speed delivering coal from the hopper to the track hoppers prior to its going to the storage pile. From the track hoppers the coal is delivered to a small initial pile by means of a conveyor known as an apron feeder. From this pile the coal is spread out into the large storage pile by the drag scraper method. The coal pile has a capacity of 12,000 tons, or, roughly, one-third of the annual requirement of a two-machine paper mill.

Coal from the pile is also reclaimed by this drag scraper, which delivers it to a skip-loading hopper, from which the skip hoist takes the coal up to the top of the coal tower in the boiler-house. In the coal tower it is fed by gravity to a reciprocating feeder, and then to a double-roll coal crusher. After being crushed the coal passes over a magnetic separator, to remove any tramp iron that is present, and is then delivered to a bunker by means of an automatic trolley which discharges it at any desired point along the bunker. The bunker has a capacity of 600 tons of coal. From it, coal is drawn into a larry which is mounted on tracks, and is movable the full length of the boiler-house in order to deliver coal to all the boilers. This larry is provided with a weighing device which enables the operator to ascertain the exact weight of coal delivered to the boilers for each day. From the larry the coal goes to an extension hopper over the individual unit pulverisers on the boilers. There is storage in the pulveriser hopper for several hours' coal supply when running at full capacity.

BOILER-HOUSE.

The boiler plant is one of the most modern equipments in Canada. The boilers are designed for a working pressure of 420 lb. per square inch. There are three main boilers and a fourth which is furnished with a wood waste burning furnace. The three main boilers are of the ring-flow Kidwell design, and have a capacity of 900 H.P. each. They are arranged with pulverised fuel combustion chambers, and have water-cooled side walls. There are two Foster Wheeler Aero type pulveriser units for each boiler. Each pulveriser delivers the coal to the boiler through two vertical pipes extending downward after going into the combustion chamber to form the burners.

This piping is so arranged that one pulveriser unit can be used at a time, and still obtain even flame distribution in the combustion chamber. The boilers are equipped with Foster Wheeler armour-type superheaters, designed to add 100 deg. superheat to the steam produced. Foster Wheeler air preheaters have also been installed to supply heated air for combustion. The boilers are equipped with both forced and induced draught fans driven by direct-connected motors. Each boiler has a separate steel chimney of the Pratt-Daniel Venturi type.

The waste-burning unit has a small combustion chamber provided with water-cooled ceiling and side walls. Waste fuel in the form of bark, sawdust and hogged wood is fed to the top of the furnace. This boiler is also equipped with branch feeders from the coal pulverisers on No. 13 boiler in order to use pulverised fuel for starting purposes and at times when there is no waste wood. To assist the operators, each boiler is equipped with meters and instruments by means of which operation can be carried out under scientific control. These meters measure the steam generated by the boiler, the air used for combustion, the temperature of gases leaving the boiler and the preheater, and also temperature of the combustion as it leaves the preheater.

Draught gauges are used at different points. They are all mounted on individual panel boards in front of each boiler, near by the controls, for varying the rate of firing in accordance with increases or decreases in load.

The steam from the boilers is delivered to a main steam header, which, on account of the high pressure used, is made of a special forged steel pipe. All of the steam from the header, under normal operation, passes into the turbine room and is delivered to a turbine of approximately 7000 H.P. capacity. The turbine is situated on the top floor of the turbine room, and there, too, are the steam control board for the turbine and an electrical control board for the direct-driven alternator to which it is coupled. The turbo-generator set was constructed by Fraser and Chalmers, and is of the combined pass-out and back-pressure type.

The turbine will pass out sufficient steam for the sulphite mill requirements through the pass-out connection at approximately 150 lb. per square inch. The remaining steam passes on through the low-pressure section of the turbine and is exhausted at 15 lb. per square inch pressure. All of the steam exhausted at the low pressure will be used in the paper machine dryers, for general mill heating and for other purposes. When delivering steam in this manner the governing of the turbine will be controlled by the back pressure. Should the turbine be used for the purpose of power only, the governing will change from back pressure to speed responsive governing.

POWER SUPPLY.

Electrical energy is supplied to the mill from three developments of the Nova Scotia Power Commission on the Mersey River. The power is brought to the mill by means of a 66,000-volt transmission line at 60 cycles. This power line enters a high-tension sub-station at the west side of the mill. There are two banks of three transformers, each transformer having a capacity of 3000 kVA and being delta connected in primary and secondary sides. These transformers deliver power on the low-tension side at 2300 volts. The equipment in this sub-station is the property of the Nova Scotia Power Commission. In addition to the transformers the necessary high-tension circuit breakers and disconnectors are also arranged in this sub-station. A low-tension sub-station is situated immediately south of the high-tension sub-station. Each 9000-kVA bank of the high-tension transformers has its own 2300-volt bus. From these buses is taken the power for the various distribution centres throughout the mill. The six grinder motors form nearly 75 per cent. of the total mill load, and therefore power for three grinder motors is taken from each bus. All motors in the mill below 50 H.P. are arranged for 550-volt service and are supplied from a bank of three 500-kVA transformers, 2300 to 575 volts, arranged in the basement of the low-tension sub-station.

The grinder motors, being synchronous motors, require direct-current excitation and that is supplied by two 200-kW motor generator sets also arranged in the basement. In the basement, too, are the field rheostats for the synchronous motors, reactors for the 2300-volt feeder circuits, and a battery room to supply direct current for the remote control of the circuit breakers. On the main floor are two rooms. In one of these are all the 2300-volt and the 575-volt circuit breakers. In the other room, which is the main control room, are the 2300-volt switchboard, 575-volt switchboard, the direct-current excitation board, and the high-tension control panels, all having remote control and being electrically operated. Adequate provision has been made to record the consumption of power on all the various feeders so that accurate distribution of power cost can be maintained.

As the public announcements as to the running of the L.M.S. "Royal Scot" may lead it to be inferred that that train makes a non-stop run, it should be said that whilst it does not call at any intermediate station for passenger purposes, it stops at Kingmoor shed going North and the Carlisle shed going South to change engines.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

FOREIGN TONGUES.

SIR,—The leading article in THE ENGINEER of the 25th ult. deserves the closest attention alike of the directors of British technical industries and of technical students; but it seems too much to hope that, under our present system of teaching, any serious impetus will be given to the study of foreign languages on the part of technical students, or that those responsible for the control of our industries will be induced to appreciate sufficiently the possession of linguistic qualifications by members of their staffs.

Attention to our neglect of language study is drawn, from time to time, in various journals, and it has been made abundantly clear, by men who are well qualified to express an opinion, that this neglect is a serious contributory factor to our present disadvantageous position in foreign markets. The reluctance to take up the study of foreign languages evinced by technical students is well worth serious investigation, since we are, as a race, not less capable of acquiring efficiently a foreign language than are any of our European neighbours, and we are, as a nation, losing or ceding ground in foreign markets to competitors better qualified in this respect.

There occurred in the article to which reference is made, a hint that the student's time is so fully occupied by his professional studies that little remains to devote to the study of languages. This idea is very current in our technical colleges and universities, and it is most unfortunate, because, while resting upon the flimsiest of foundations, it is seized upon avidly, by student and teacher, as a valid excuse for avoiding foreign languages.

The contention that the excuse is a poor one is upheld by the fact that technical students in many other countries acquire, as part of their course, a knowledge of at least one foreign language, and in many cases two and three. In China and Japan every engineering and science student must have an efficient knowledge of English and most know German as well. The same may be said of Scandinavia and the Baltic Republics. In Germany, Switzerland and Greece, most technical men have a knowledge of two and even three other languages. If it is possible for these races to acquire a working knowledge of foreign languages, as well as to pursue their technical studies, it is no less possible for British students.

The presentation of at least one foreign language is compulsory on the part of candidates for the leaving certificate and university entrance examinations, and such presentation presupposes from three to five years' study of the language offered, during which the student has gone through the distasteful, but necessary, drudgery of learning the grammar, with its endless rules and exceptions. Then, just as he is, as it were, on the threshold of a new world, he is deprived of his teacher's guidance, and in the majority of cases he sinks back into his original darkness. If it were pointed out to students that the three to five years' study of a language, which they have completed for their matriculation, has enabled them to traverse the most difficult and tedious part of the road, and that a little further study would reward them by an ever-increasing facility in the use of the language, many of them, so encouraged, would make the effort to do the reading and little extra study required to enlarge the vocabulary and increase the knowledge of idiom, structure and style, necessary for proficiency and fluency.

The result of neglecting to give this encouragement is doubly to be deplored; the student not only loses all he has acquired so arduously, but he can only in rare cases be persuaded in later years to take up the study of the language he has once let drop, because all he remembers is the drudgery necessary to acquire the grammatical knowledge, and the task appears to be supremely distasteful.

There is an aspect of language study which is seldom, if ever, brought to the notice of students. That is the decreasing difficulty which attends the acquisition of successive languages, due to the gaining of experience, which seems to create a language sense.

The mastering of one's first language is a task of great difficulty, requiring immense effort of mind and memory, and it is a task which is rightly required of the student before he embarks upon his professional studies. On proceeding to the second foreign language, it will be found that the task is not nearly so difficult. One is less bewildered by grammatical forms and structure, the vocabulary is more easily acquired, and one more quickly arrives at the stage at which some power in using the language is felt, which is a great inspiration to carry on the task to completion.

Students must remember that there is no royal road to learning a language. Success requires hard work and, above all, constant and methodical work. They will be well advised to disregard the allurements of certain types of language schools and printed courses, the latter mostly emanating from Germany, which offer to teach a language "in four months without drudgery and without grammar." Such claims are quite absurd, and thousands who commence such courses give them up disheartened and disillusioned.

Lest those who read this letter should be tempted to consider it a counsel of perfection, the writer would add that, besides qualifying as a civil engineer and geologist, he has acquired five European languages, and withal was never considered as a very promising student at college. Moreover, he has had a fair share of life's amusements.

August 5th. TRIFERRIC.

62,500-kVA Turbo-Generators at the Goldenberg Power Station, Germany.

The Goldenberg station of the Rhenish-Westphalian Electricity Company is the largest steam power station in Germany. As long ago as the year 1919 it contained turbo-generators rated at 62,500 kVA each, which were at the time by far the largest machines of the kind in the world. They were constructed by the Allgemeine Elektricitäts Gesellschaft, of Berlin, and each consisted of a single-cylinder turbine driving a six-pole generator at 1000 revolutions per minute. Their behaviour was so satisfactory that two more units of the same rating and speed were put down in 1924. Last year it became again necessary to increase the capacity of the station by the addition of another pair of machines. The same nominal size of unit was adhered to, but this time, owing to developments in the art of constructing large generators, the Allgemeine Elektricitäts Gesellschaft increased the speed of the machines to 1500 revolutions per minute.

By the courtesy of the builders, and the kindness of Dr. Robert Pohl, the chief engineer of the A.E.G. alternator department, well known to English engineers from his long association with the old Phœnix Dynamo Company, we are able to give some particulars of these interesting machines. Their appearance, as seen from the steam end, is shown in Fig. 1, which illustrates the interior of the engine-room at Goldenberg with the two new turbo-alternators in the foreground. The alternator itself, with its attached exciter, is better shown in Fig. 5, while Figs. 2 and 3 give details of its construction. The somewhat unusual shape of the stator casing is at once noticeable. This is due to the incorporation in it of the air coolers. The object is to reduce the volume of the circulating air to the lowest practicable limit, and further to attain a simplicity and compactness which will render easy the exclusion of external air and dust. By arranging the coolers on each side of the machine, as shown, the quantity of air enclosed is only about one-quarter of that which there would have been in the system had the coolers been placed in the foundations separately from the machine, according to the usual practice. This reduction of the air in circulation ensures that, in the case of a fire starting in the machine, it will be automatically extinguished practically at once by the want of oxygen to support combustion. Each of the side coolers is made up of two parts, each provided with wheels. By undoing the necessary connections these parts can be run out of position separately for examination or repair, rails being let into the flooring for that purpose.

Fig. 1—Interior of Engine Room

Perhaps the most distinctive feature of the alternator itself is the construction of the rotor. The windings are not embedded in slots cut in the solid metal, as is the usual standard practice, but are held between laminated teeth inserted in the solid core of the rotor. This method of construction possesses many advantages. In the first place, it permits a forging of much smaller diameter to be used for the rotor, which is a great consideration in view of the difficulty of getting sound and homogeneous forgings of large size in special steel. The reduction in diameter also facilitates heat treatment and makes the results more reliable. There is, further, no possible doubt as to the strength and quality of the teeth, as they are built up of thin laminations riveted together. It will also be evident that the construction permits of completely finished, taped and insulated coils being used in conjunction with semi-closed slots, for the coils can be put in their place before the teeth which separate them are fixed in position. The usual method of winding in the individual strands of

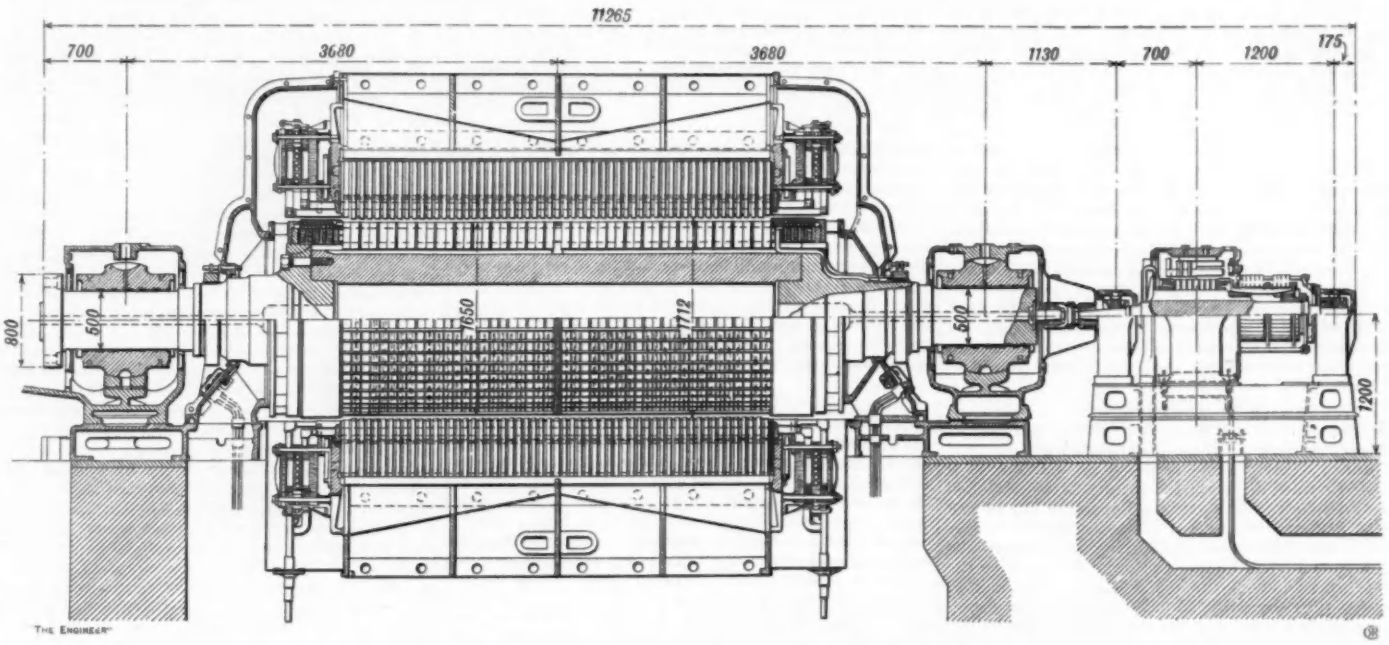


Fig. 2—Longitudinal Section Through Generator

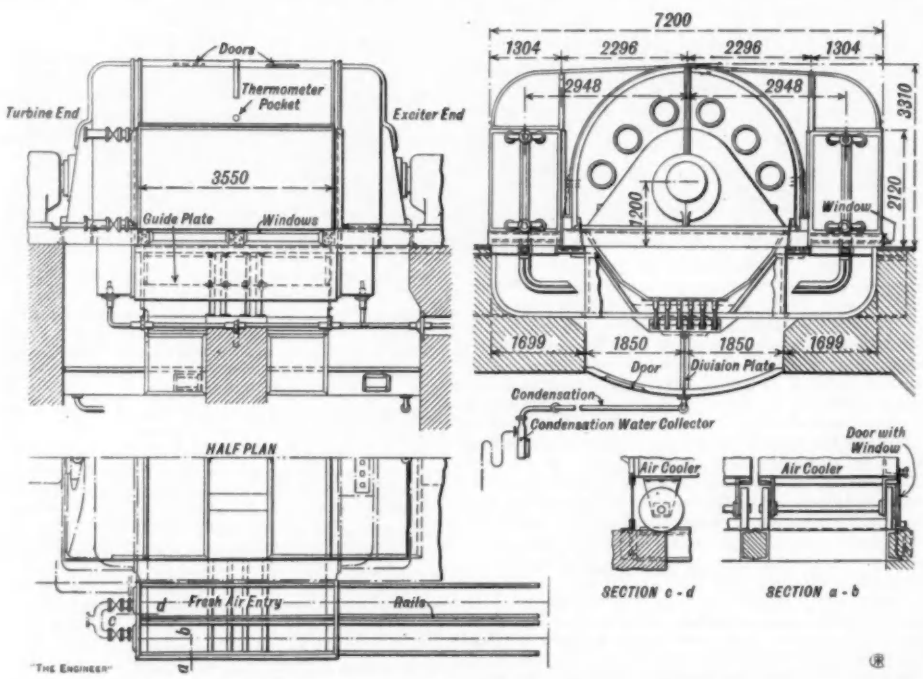


Fig. 3—Cooling Arrangements for Generator

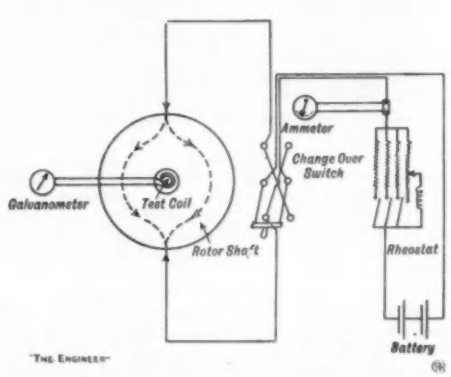


Fig. 4—Arrangement for Testing Rotors

62,500-kVA TURBO-GENERATOR AT GOLDENBERG POWER STATION

THE ALLGEMEINE ELEKTRICITATS GESELLSCHAFT, BERLIN, ENGINEERS

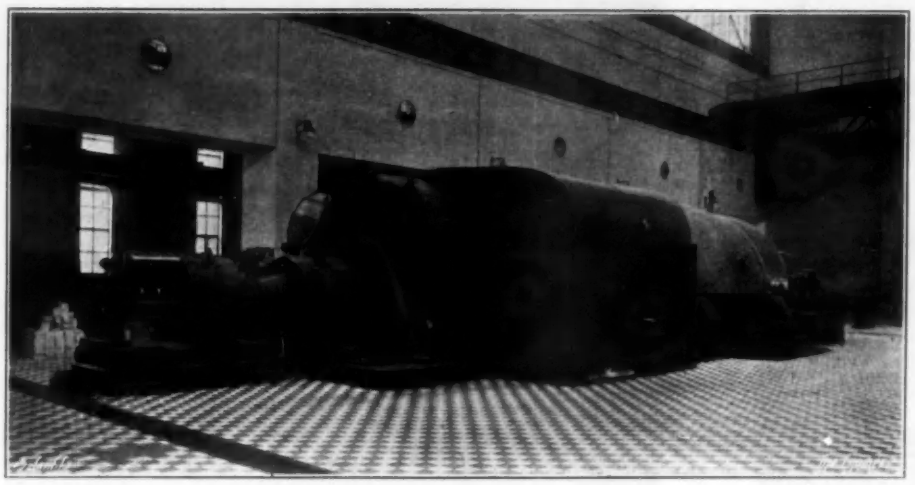


FIG. 5

the coils turn by turn is thus eliminated, the completed coils being put into position as shown in Fig. 6, page 148. The end turns are held down on to their seating by caps at the end of the rotor, so that no displacement is possible. The appearance of the rotor with all coils and teeth in position is shown in Fig. 7, while Fig. 8 shows it in its completely finished state shipped for transport. It has an outside diameter of practically 65in. and an overall length of 27ft. 11in.

The difficulty of ensuring absolutely faultless rotor forgings of large size has already been mentioned. To prevent any unsound material finding its way into the finished product the Allgemeine Elektricitäts Gesellschaft has developed an electrical process for detecting the presence of flaws or cracks in the body of their rotors. The principle will be clear from Fig. 4, which shows the arrangement diagrammatically. After the rotor has been bored and rough machined, it is taken to a test room and a heavy current passed between two diametrically opposed points on its surface. Inside the bore is placed an exploring coil, consisting of many turns of wire, which is connected to a mirror galvanometer. If the metal of the rotor is homogeneous and free from flaws the current will flow equally on each side of the bore. There will then be no magnetic field in the bore, so that an interruption or reversal of the current will have no effect on the galvanometer. Should, however, the current distribution in the rotor be unsymmetrical, its interruption will cause an induced current in the test coil, with the result that the galvanometer will be deflected. Fig. 9 shows the rotor of a machine to develop 40,000 kVA at 3000 revolutions per minute undergoing this electrical test. The four cables bringing the current to the contact clamped on top of the rotor are clearly to be seen.

In addition to the test mentioned, the interior surface of the bore of all rotors is examined optically. For this purpose a cinematograph device has been developed. It gives a greatly magnified picture of the whole of the circumference at once. By moving the apparatus along the bore a continuous picture is obtained. This thorough examination of material, coupled with the use of rigid pre-formed windings, permits the Allgemeine Elektricitäts Gesellschaft to impose an unusually severe mechanical test on its finished rotors. These latter, even for 3000-revolution machines, are run continuously for half-an-hour at an overspeed of 30 per cent. before being dispatched from the works.

American Engineering News.

Cleveland's New Joint Station.

THE great union passenger station at Cleveland, Ohio, which was put into service on June 28th, represents a cost of about £18,000,000 for the station itself, its approaches and the electrification equipment. But this actual expense has been nearly doubled by extensive auxiliary works. Thus the three railways using the station have spent about £8,000,000 on additional tracks, goods stations, running sheds, and locomotive facilities. Electric suburban and interurban railways, in order to enter the station, have spent about £4,000,000 on new approach lines and connections. Besides this, a company has spent some £6,000,000 on lofty "air-right" office buildings and hotels erected over the tracks and station property. Above the passenger facilities rises a fifty-two storey office building, like a great tower of very attractive architectural design. Owing to the selection of a new site in the very centre of the business district, instead of the more favourable original site on the edge of this congested district, the station is rather awkwardly situated in the apex of a V, so that the platforms are of varying lengths, and are curved at each end, while the platform tracks have fairly sharp curves at each end. There are twelve station tracks for steam trains and six for electric trains. All are laid with 127 lb. flat-footed rails on creosoted wood blocks set in pockets in a concrete floor slab. The tracks are 30ft. below the street level, owing to topographical conditions, and are 20ft. below the main concourse which spans them. The electrified section is only 4 miles long at present, but will be extended to 18 miles. All main line trains are handled by 200-ton electric locomotives, having six driving axles, in two groups, with a four-wheeled bogie at each end. The electric local trains will consist of multiple-unit cars. Both the locomotives and multiple-unit trains take 3000-volt direct current from overhead wires.

New Portland Cement Works.

One of the latest additions to the large number of cement works is a wet process plant in Texas, built adjacent to a quarry which furnishes both clay and limestone. A self-propelling electric well drill puts down the blast holes and the rock is loaded by electric excavators into 8-yard standard-gauge quarry cars which are hauled in trains by a petrol locomotive to the crusher, which can handle rocks of 2 cubic yards and reduce them to a $\frac{3}{4}$in. size. The slurry from the grinding mills is fed to tanks, the composition being checked hourly by the chemist and adjusted to the desired analysis. There are two steel kilns, 12ft. in diameter and 250ft. long, each supported by four rings riding on rollers. The kilns, which have a slope of $\frac{1}{4}$in. per foot and are motor driven at about 1 revolution in forty seconds, may be fired either with gas or oil. The clinker produced is vitreous and black, and is unaffected by weather. It is discharged at about 2000 deg. Fah. and it goes first to cooling pits and then to the storage bins from which the grinding mills are fed. These mills are of the hammer type, the clinker entering through a hollow trunnion. The finished cement is blown by compressed air through a 5in. pipe having branches to silos 24ft. in diameter, with an aggregate capacity of 153,000 barrels. A system of conveyors delivers the cement either to the bins of packing machines or to spouts for loading cement in bulk in railway cars. Machinery is provided for beating and cleaning returned sacks, and the entire plant is equipped with dust collecting apparatus.

Rural Electrification.

From a recent survey it appears that about 625,000 farms in the United States are now receiving electric service from high-tension transmission lines at a cost of 2$\frac{1}{2}$d. per horse-power hour, as compared with 7$\frac{1}{2}$d. for current from small local power stations or 1s. for that from an individual power plant on the farm. Besides the tangible benefits, there are many intangible benefits, such as good lighting in house and barns, water distributed by pressure through house and yards, instead of being pumped by hand and carried in pails, and many conveniences and labour-saving appliances for the use of the farmer and his wife, relieving the latter especially of much drudgery. Thus the cheap power can be utilised for washing and ironing machines, cooking stoves, heaters for rooms, heater pads for sickness, sewing machines, vacuum cleaners, fans and food refrigerators in summer, radio, &c. For farm work it can operate pumps, churns, saws, feed mills, &c. The cost of rural electric distribution lines is about £200 per mile. As yet the use of electricity is mainly on farms operated by their owners, but the time may be foreseen when it will not be easy to rent farms which are not supplied with electricity. Rural electric lines have increased enormously within the past ten years, and they are being developed on an extensive scale by many electric companies. A leading factor in the further use of electricity will be the introduction of special rates, so arranged that as the consumer takes more current the cheaper will be the additional current. With the lines extended the electrification of farms will be assisted by reducing to a minimum the cost of adequate and safe wiring, and the price of the necessary equipment. Many farms having electric service use a 3 kilovolt-ampère transformer, which is sufficient for lighting and small appliances, and for a 5 H.P. motor when other equipment is not in use.

Self-unloading Steamers.

For handling such bulk cargoes as sand, gravel, crushed stone, cement, and coal, several large steamers on the Great Lakes are fitted with apparatus for discharging their cargoes without the aid of dock or shore appliances. Cement is sometimes forced through pipes and flexible hose by compressed air, and is thus delivered directly to storage bins without creating dust. Sand is either pumped ashore by centrifugal hydraulic pumps, water being added to the ship's hoppers while unloading, or it may be handled mechanically. By one system it is excavated dry from the hoppers by grab buckets, which are either handled by revolving jib cranes or by trolleys travelling on a runway, which can be extended as a cantilever beyond the ship's side. Coarse material, such as broken stone, which is shipped from quarries to blast-furnaces as flux, may be carried in funnel-bottom hoppers, built into the hold, and having gates by which the stone is fed to a belt conveyor just above the keel. Near the bow the stone is delivered to an inclined bucket conveyor, which, in turn, discharges it upon a belt conveyor carried in a long steel truss which is pivoted at the heel so as to be swung at right angles to the ship and deliver the cargo to stock piles or bins on shore. A recent modification of this system is to replace the bottom conveyor by a scraper bucket operated in a tunnel by means of drag and back-haul cables. Doors or gates in the bins within the hull allow the material to flow into the tunnel, where it is drawn forward by the bucket. Near the bow the bucket rises up an incline and discharges the stone on to a steeply inclined conveyor which discharges on to a belt conveyor carried on a long steel jib whose outboard end, when in use, is supported by cables from a steel frame or tower on the deck of the vessel. With a 10-yard bucket moving at 400ft. per minute about 1200 tons per hour can be unloaded. Steamers carrying rolls of print paper for newspapers have revolving cranes for loading and discharging the cargo.

Combined Steam and Hydro-electric Plants.

On the Mokelumne River in California, the Pacific Electric Company is building a series of reservoirs to supply hydro-electric plants developing 171,000 kVA, to meet the increasing demands for power. At present the company has hydro-electric plants of 500,000 kVA and steam plants of 200,000 kVA. At the Salt Springs site on the river the company is building a rock-fill dam, 330ft. high, with a length of 1300ft. on the crest, having slopes of 1$\frac{1}{2}$ to 1 on the upstream side and 1$\frac{1}{2}$ to 1 on the downstream side, and with a volume of some 3,000,000 cubic yards. For water-tightness the upstream slope is laid with large derrick-placed rocks for a thickness of 15ft., faced with concrete ranging from 36in. thick at the toe to 12in. at the top. This concrete is poured in slabs, 60ft. square, with copper expansion joints between the slabs. The spillway or waste weir is a channel excavated in solid rock, and having its crest 625ft. long. The reservoir storage will be about 130,000 acre-feet. To carry the river flow and floods during construction, there is a tunnel 20ft. in diameter and 920ft. long. After completion of the dam, the outlet end of the tunnel will be closed with a massive concrete bulkhead or plug, with two 10ft. discharge pipes fitted with butterfly valves, so as to provide for lowering the water level rapidly if needed. The power equipment will include a vertical shaft generator of 11,000 kVA, coupled to a turbine of 13,500 H.P., running at 300 revolutions and generating current at 11,000 volts. The hydraulic turbine will pass 550 second-feet at 240ft. head. There will be also an impulse wheel turbine operating under 2000ft. head from another reservoir. This wheel will be of 30,000 H.P., driving a horizontal shaft generator of 25,000 kVA. All the water passing through this station will be discharged into Tiger Creek, and serve another station equipped with two impulse wheels of 36,000 H.P. each.

Electric Scoreboards at Wimbledon.

By ROBERT A. SMITH, M.I.E.E., M. Cons. E.

WHEN the Committee of the All England Lawn Tennis and Croquet Club decided that some improvement must be made in the established method of indicating the score by hand-operated cards during the Tennis Championship meetings on the Centre Court at Wimbledon, the writer investigated several ingenious devices for selecting and exhibiting numerals written on cards, drums or roller blinds, controlled by both electrical and hydraulic means, but came to the conclusion that the system of forming the figures by electric lights possessed the greatest number of advantages, particularly in that of rapid construction, small space occupied by apparatus, and speed in operation.

An early application of the grouping of incandescent electric lights to form the outlines of numerals is to be seen in the indicator board used in certain places of entertainment, which announce by number the "turn" about to be performed. The speed with which any numeral thus exhibited may be changed into another by a re-grouping of the lights is limited only by the rate at which the lamp filaments will become incandescent, and, for the practical purposes of conveying information, this may be taken as being instantaneous.

Some preliminary trials were made to determine the best number of lamps per unit to form the figures. This naturally depends to a great extent on the distance from which the announcement is to be read, the difficulty being to distinguish at a distance between, say, a "3" and an "8." The standard arrangement used in totalisators is a unit of four lamps in width and six in height, but in this case, as the figures had to be read from a distance of 250ft., it was found that units of seven lamps in height gave better definition and that number was consequently adopted. Each lamp unit consists, therefore, of twenty-eight cells, but as three of these cells are not required in the formation of any numeral, the unit for all figures from 1 to 0, contains only twenty-five lamps, each of 15 watts. In the type of lamp unit adopted the lamp cells are covered by a screen of fine copper gauze, which removes any glare and greatly increases the definition. The contractors guaranteed that it should be possible to read the figures through a horizontal arc of 120 deg.; in practice they are readable up to 140 deg.

For the championship meeting in 1929 the old

ELECTRIC LAWN TENNIS SCOREBOARDS AT WIMBLEDON

FIG. 1—CONTROL BOARD

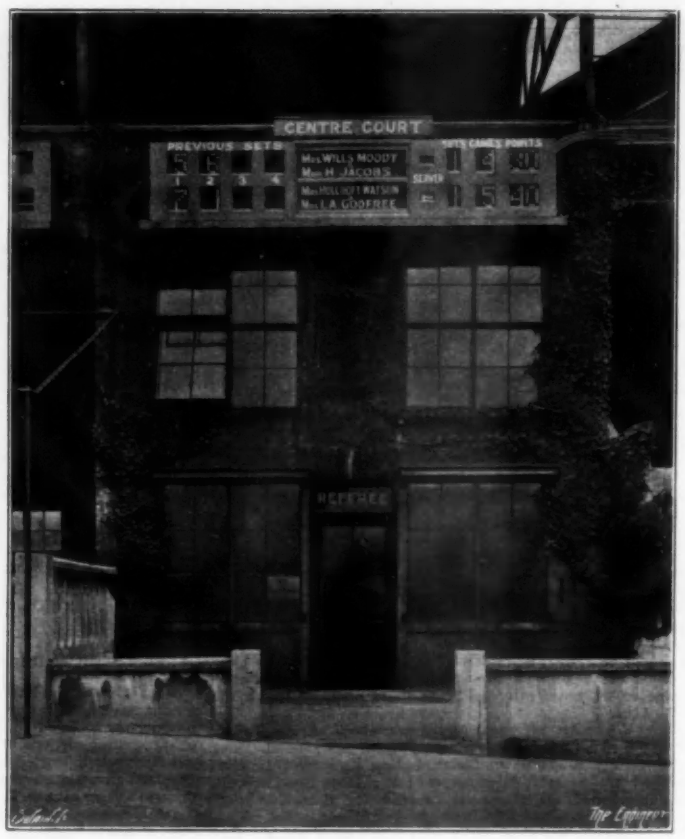


FIG. 2—CENTRE COURT SCOREBOARD

FIG. 3—SCOREBOARD OVER REFEREE'S ROOM IN MAIN AVENUE

"ports" or openings through which the score cards were exhibited in the two existing score boards in the Centre Court, were equipped with lamp units, and a new "repeater" board was fixed outside the building, where it would be visible from the grounds. The original idea was that the scoring should be done by the umpire, and to this end two small push-button boards were constructed which could be fitted to the umpire's chair. The boards were identical, one for each competing side, and carried four pushes marked "Points" 15, 30, 40, Advantage; ten pushes marked "Games," 1 to 0, with a switch to prefix the integer 1 if the games ran to more than 9. "Sets" were shown by a two-position and "off" switch, which brought up the numerals either 1 or 2. As a momentary depression of any button altered any previous combination and brought up and maintained the numeral represented by the button pressed, it was therefore necessary to have a "blank out" button to extinguish the lights at the close of the game.

Only twenty conductors were required from each push-button board, made up into a flexible cable and led to a multi-contact plug by the side of the court, from which multi-core cables led to the three score boards in parallel. At each score board a bank of Ericsson's selector relays and rotary line switches picked out the combination of lamps producing the numerals required. These worked admirably throughout the season, but it was soon found that even the pushing of buttons was impossible when added to the other duties of the umpire; therefore the push buttons were mounted on a desk beside the umpire's chair, where they were manipulated by a special operator during the matches.

The success of the experimental score boards in the Centre Court in 1929 led the Committee to extend the system this year to No. 1 Court and to make it a permanent feature. At the same time the Committee desired that the boards should be lengthened to show simultaneously the games scored in each of the five sets comprised in a match. As now constructed the boards are therefore 16ft. long and 3ft. 3in. wide, carrying two horizontal rows of ports. Four ports to the left of the players' names in each row show the games in previous sets; to the right of the names are ports, arranged as before, showing the sets, games, points and, in addition, an arrow indicating which side is serving. There are two such boards in the Centre Court and No. 1 Court respectively, with a repeater board from each fixed over the referee's room, where the scores can be seen from the outside courts.

As experience had shown that an operator, other than the umpire, was necessary to manipulate the controls and as it was unnecessary for that operator to be on the court itself if in telephonic communication with the umpire, the *raison d'être* of the push-button system of control had disappeared. The writer therefore recommended that the operator should be housed in a special cabin, preferably immediately behind one of the score boards in each court, where he would receive the umpire's instructions through a loud-speaking telephone and could control the lamp units by direct multi-contact switches, instead of through relays, using standard apparatus identical with that employed in a hand-controlled totalisator. This system involves many more conductors than does the relay system; but, having once fixed the permanent wiring, the rest of the apparatus is simple; it can be quickly installed and as quickly removed, either for safe storage or to do duty on another site.

A reinforced concrete cabin was accordingly built behind the north score board of the Centre Court and another behind the west score board of No. 1 Court for the accommodation of the controllers and operators. Power was supplied to each cabin at 220 volts single phase from the mains of the Wimbledon Corporation.

The controller for each court carries twelve vertical, drum pattern, twenty-contact, stepped switches, with ten active positions, manipulated from knobs projecting above the controller case. These switches are arranged to select and group the lamps required for the numerals in regular sequence; but the full number of contacts is used only in the case of "Games," and when these run to ten or more, the figure 1 is introduced by a separate single-way switch. For "Points" only four positions are required and fewer lines, but the same switches are used for the sake of uniformity.

The controllers are connected to their respective boards by three multi-core lead-covered cables, each cable containing eighty conductors of ·001 square inch section with V.I.R. insulation. The actual number of outgoing signal wires is 216, the common returns number 24, making 240 altogether. Messrs. Henley supplied and erected the cables and cast iron junction boxes for paralleling the outside repeater boards.

At the termination of each cable the lead cover is wipe jointed to a cast iron terminal box carrying a 90-way plug, which was the nearest standard size available. From these multi-circuit plugs the local wiring is grouped in multiples of twenty conductors or less, as required, and flexibly connected to one half of a twenty-way plug, the other half of which is carried by the lamp unit in each case.

The lamp units are sheet steel boxes divided by steel partitions into cells, as already described. In each useful cell an ordinary B.S. lamp holder is fitted and permanently wired to the fixed half of the twenty-way plug. Each unit fits into a rebate in the back of the board and completely fills its "port," being kept in position by a simple drop button. A handle is provided on the back of the unit to facilitate its withdrawal from the board for lamp replacement. The disconnection of any lamp unit for testing or repairs is therefore simply a matter of withdrawing its multi-circuit plug. Controllers and cables may be similarly disconnected; happily, however, the work of installation had been so carefully done that no breakdown of any kind occurred during the summer meeting, other than two or three filament failures out of the 2640 lamps employed, a result most creditable to the British Automatic Totalisator, Ltd., which contracted for both the 1929 and 1930 installations, the former having been constructed and completed in only eighteen days from the date of order.

Score boards, partly electrically operated, have been tried at tennis tournaments on the Continent, but this is the first instance anywhere of the complete score having been displayed electrically, and its unqualified success opens a field for the further adaptation of the system to other sports. For instance, it might be applied to the immediate recording of analysed and aggregate cricket scores. In this case each run by a batsman could be displayed as made and automatically added both to his individual total and to the aggregate for his side. Football results could be indicated in the same way, and in yacht racing recall numbers could be shown instantaneously, the extinguishing of the figures being the signal that the recalled yacht had worked back clear of the line.

R.I.B.A. MAINTENANCE SCHOLARSHIPS IN ARCHITECTURE.—The Royal Institute of British Architects asks us to announce that the R.I.B.A. Maintenance Scholarship (1930) of £100 has been awarded to Ralph Dickinson, of the Birmingham School of Architecture. The scholarship is tenable in the first instance for one year and renewable for two further periods of one year each. In addition the following scholarships, previously awarded, have been renewed for a further period of one year each:—G. G. Laidler (£100), Architectural Association School of Architecture; Hubert Bennett (£100), School of Architecture, University of Manchester; F. W. Wright (£100), School of Architecture, University of Sheffield; and A. K. Brown (£50), School of Architecture, Armstrong College, Newcastle-on-Tyne. The Artists' General Benevolent Institution Scholarship (£100), which is administered by the R.I.B.A., has been awarded for a further year to J. F. D. Wylson, Architectural Association School of Architecture.

"REPERTORIUM TECHNICUM."—The Committee of the Nederlandsch Instituut voor Documentatie en Registratuur asks us to announce that, given sufficient participation, it hopes shortly to issue the first number of a periodical under the title of *Repertorium Technicum*. This periodical, which, at the outset, will appear in bi-monthly issues of approximately sixty sheets printed on one side, will comprise a systematically arranged bibliography of the more important publications of a technical nature appearing both in book form and in periodicals. To the articles mentioned therein there will be added, as far as possible, notices of the abstracts by which it will be possible for those interested first to consult the more easily obtainable abstracts before obtaining the respective articles. It is further intended to attach to each issue an alphabetical index of headings, whilst for the more detailed subdivision the universal decimal classification will be followed. At the end of the year a systematic and alphabetical index will be appended. It is proposed to include approximately 12,000 titles per year, which number will gradually be extended. The price of the periodical is to be £3 per year. Further particulars may be obtained on application to the Nederlandsch Instituut voor Documentatie en Registratuur, 30, Carel van Bylandtlaan, The Hague, Holland.

Railway and Road Matters.

ALL locomotives on the railways of India, whether State managed or privately operated, and whether working passenger, mixed or freight trains, running on the main lines and important branches, are to have electric headlights by April 1st, 1932.

THE Road Traffic Bill received the Royal Assent on Friday, the 1st instant. A pleasing incident marked the close of its progress through Parliament. Though Colonel Ashley, the Minister of Transport in the late Government, was one of its severest critics, it was he who seconded the motion for the third reading.

THE self-propelling railway coach, driven by a storage battery invented by Dr. James Drumm, about which there has been a considerable amount of mystery, was tested in public on the Great Southern Railways of Ireland on Thursday, July 31st, and a speed of 35 m.p.h. is reported to have been attained.

THE Cologne railway authorities propose to build a large new bridge over the Rhine at Wiesdorf for the fast railway service between Cologne and the Ruhr district. The total length of the bridge will be about 1000 m., of which 400 m. will be taken up by the approach work on the right bank of the Rhine and 300 m. by similar work on the left bank. The actual bridge across the river will therefore be 300 m. long and will consist of a single span. The work is to be completed in 1934.

THE Assam-Bengal Railway is one of the few privately owned railways in India, and comparatively a new concern. It was constituted in 1892, and the contract with the Indian Government, whereby the latter can acquire the line, was for forty years, and expires at the end of next year. It is, however, renewable for periods of ten years. The Legislative Assembly has decided, however, that the negotiations with the railway company shall be with a view to acquiring the line at the end of 1932.

A CORRESPONDENT in *The Times* of July 23rd, whilst agreeing that the Great Western's 2.30 from Cheltenham deserves the name of "Cheltenham Flyer," in respect of its journey between Swindon and Paddington, thinks that its earlier stage from Cheltenham to Swindon might rightly be called the "Cheltenham Tortoise," as it requires an hour—actually it is 51 minutes—to cover the 31¼ miles between Cheltenham and Kimble. We would, however, point out that in that time it has to call at Gloucester and Stroud for station duties and has to negotiate heavy gradients and sharp curves.

THE rejection by the Government of the Channel Tunnel scheme has led to, among other events, the proposal in *The Times* by Sir Eustace Tennyson d'Eyncourt that there should be a Channel ferry. That led to a reply from Mr. Thomas Rhodes, who, speaking evidently with inside information, said: "The late Lord Pirrie went into the question with, I think I may say, enthusiasm. He had the necessary type of steamer designed and every detail connected with the project thoroughly examined, especially as to cost and working expenses. He told me that, to his astonishment, when he submitted his carefully elaborated scheme to the French they declared themselves incurious and that they would not spend sixpence on a Channel ferry."

SOME persistent inquiries have been addressed in Parliament to the Minister of Transport as to the number of railway servants employed now on British railways in comparison with 1913, one inquiry being whether the railway census included persons employed in connection with omnibus and other motor services. Mr. Morrison replied in the affirmative as to the latter, and on the general question said that he was unable to give strictly comparable figures for 1913 and 1928. It was, however, estimated that the later return included approximately 40,500 persons employed in businesses which were not covered by the return for 1913. Lest it should be thought by our readers that these additions refer, even mainly, to omnibus and other motor services, we would say that the census for 1928 had only 643 such servants and that for 1929 had 806.

DURING the last ten years over a million trees have been planted on territory adjacent to the G.W. system, which is unsuitable for agricultural purposes or was denuded of trees during the war. As a result the beauties of many parts of the territory served by the company will in time become enhanced, and districts which at present are barren will be converted into thriving and productive areas. Altogether, some 27,000 acres of land have been planted, most of it being in Wales, and in such famous districts as the Snowdon Range, Cader Idris, near Dolgelley, Plynlimmon, on the Cambrian Coast at Devil's Bridge near Aberystwyth, Tintern, Exmoor, Quantocks, and the Forest of Dean. The nearest place to London on the G.W.R. where afforestation has taken place is Mortimer, near Reading, where some 2188 acres of trees have been planted.

THE proposal in *The Times*, and at greater length in the *Spectator*, of Mr. Alfred C. Bossom, that the railways of the main line companies in London should be converted to electric traction and then, because there would be no smoke, have them covered in and buildings and streets erected thereon, has, that gentleman says in a further letter to *The Times*, brought him "a very considerable correspondence with distinguished individuals and various public bodies and societies, all of them animated by the same ambition—the betterment of London." Mr. Bossom bases his proposal on the conversion of Park-avenue tunnel in New York City, but that line is, like our own Metropolitan and Metropolitan District Railways, below street level, and what has been covered over is the yard of the Grand Central Station, and the long spaces left open for ventilation purposes. The difficulty in London is that practically all the lines enter the Metropolis on a high level and drop down into the terminus, *e.g.*, at Euston, King's Cross, and Liverpool-street, or the stations are above street level, as at St. Pancras, Waterloo, and Fenchurch-street. The only railway that approaches London below street level is the former Great Central into Marylebone, and that has always been covered in, *e.g.*, under Lord's Cricket Ground.

Notes and Memoranda.

LONDON is the most dense telephone area in England, with one telephone per 9·2 inhabitants. Guildford comes next with one per 9·7 inhabitants.

IT is claimed for the Diesel engine-driven plant at Hudson, Massachusetts, which has a total capacity of 1690 kW in three sets, that the generating costs are 1·079 cent per kilowatt-hour, including overhead charges.

THE Manchester Corporation employs an electric battery, articulated, six-wheeled vehicle of 10 tons capacity for carrying electric cables about. This machine has now done three years' service and has covered 29,000 miles. The tires and the Exide battery have just been replaced for the first time.

OFFICIAL records show that in New Zealand there are 10·3 telephones per 100 of the population. In Great Britain the proportion is 3·8 to 100. The Post Office recently stated that experiments are being carried on with a view to the early establishment of wireless telephone communication between this country and New Zealand.

IT has been found necessary to keep under control the mosquitoes breeding round the shore of the Saluda dam in South Carolina, which is 500 miles long. For this purpose three small motor boats are used to spray the shallow water with oil. A 2in. centrifugal pump sucks water to which oil is added in the proportion of 1 in 100 and delivers the mixture through a ½in. jet to a distance of from 60ft. to 80ft. The boat travels at a speed of 3 to 4 miles per hour. Where the banks are weedy, Paris green and hydrated lime in the proportions of 5 to 100 are sprayed by a portable blower.

SOME investigations have been made by Drs. W. Mull and H. Reiter on the thermal insulation properties of air in walls. They find that for dwelling-houses the best thickness of the air layer in a cavity wall is 5 cm. if it is limited to a single layer. Multiple layers give better insulation than a single layer of the same total thickness. The rate of transmission of heat through an air layer depends on the radiation constant of the surfaces bounding the layer, on the mean temperature of the air, on the difference of temperature of its surfaces, on its thickness, and, in the case of a vertical layer, on its height.

FOUR wells in the Santa Fé Springs oil field in California were, says the *Engineering News-Record*, recently sunk to a depth of 8000ft., the latter part of the drilling being done with a 2in. fishtail bit. While this depth is not a maximum for oil well drilling, it is claimed by representatives of the Union Oil Company, by which the holes were put down, to be the greatest depth for such a small drill. The reason for the small diameter was that the wells were originally driven to a much shallower oil deposit and the decision to go to the 8000ft. depth, working inside the casing already in, was the result of later discoveries. All four of the holes, it is claimed, show a deviation from vertical from top to bottom of less than 5 deg., and to this high degree of accuracy in keeping the holes plumbed is attributed the success with the small bit.

IN an editorial article on the evil effects of noise on the health of human beings, based on the findings of a New York committee, the *Engineering News-Record* says: "The committee in its report just made public cites rivet hammers, power shovels, rock drills, pile hammers, hoisting machinery and motor trucks as outstanding offenders in creating noises. Welding is put forward as one means of eliminating riveting noises. A curb on all construction and demolition work at night in residential sections is suggested in the interest of healthful sleep. A veiled threat that manufacturers and users of construction equipment may soon be faced by public opinion or official mandate to devise effective mufflers is contained in the report. It is plain that the construction industry must soon cease to disregard this trend of the times."

IT is reported from Worcester, Massachusetts, that Professor Robert H. Goddard, of Clark University, in that city, has carried out such successful experiments in rocket propulsion to extreme altitudes, that a grant has been made by the Daniel Guggenheim Fund for the Promotion of Aeronautics for the continuation of his work. Professor Goddard began his present series of experiments in 1912–13, while at Princeton University. The rocket is propelled by the thrust produced by expelled gases created either by igniting powder or by causing the combustion of two liquids. Basically, it is much like an ordinary skyrocket. While experiments with powder rockets have been successful, indications are, it is said, that the liquid propellants are much more efficient and are capable of greater development. The rockets used so far have been very small, but are reported to have been uniformly successful. No immediate experiments with large rockets are contemplated.

WRITING to *Nature*, Mr. C. J. Smithwells, of the research laboratories of the General Electric Company, gives the following procedure for making prints on copper:—The copper or brass surface is polished and cleaned as for engraving, and dipped for 10 seconds into a 10 per cent. solution of cupric chloride or copper ammonium chloride. A very thin white film, which X-ray examination shows to be cuprous chloride, forms on the surface of the plate. The plate is washed in running water, rinsed in methylated spirit and dried in the air. The methylated spirit not only accelerates drying but also makes the film much more adherent, and the wet plate can be wiped with a cloth without the film being destroyed. The plate is now light sensitive. On exposure for a few seconds to the direct light from an arc lamp the surface turns black, owing to the conversion of cuprous chloride into cuprous oxide. For contact prints from ordinary negatives an exposure of about 1 minute to the light of an arc lamp is required. The image—positive—so obtained is about equal in definition and contrast to that obtained in the ordinary three-colour and photogravure processes. The image can be "fixed" by washing in dilute hypo or salt solution, but since this also reduces the intensity of the image the plate should be over-exposed during printing. For many purposes, such as engraving, fogging by diffuse daylight is so slow that fixing is unnecessary.

Miscellanea.

TELEPHONIC connection has been made between the island of Skye and the mainland.

THE new airport beacon at Calgarry, Alberta, is to be equipped with neon lamps of some 30 kVA.

IT is estimated that the gold output of Canada next year will be at the rate of 61,000,000 dollars per annum.

A CENTRAL steam heating plant, which will cost 2,000,000 dollars, is to be put up at Haskins-avenue, Winnipeg, Manitoba.

THE first report of the Swedish Magnetic Observatory, which has a latitude of 59 deg., has just been published. Its data are minute and extensive.

THE Windsor-Detroit Tunnel, between Canada and the United States, was holed through on July 14th, and it is expected that it will be opened to vehicular traffic in November.

CONTRACTS have now been settled for the construction of a new pier in Vancouver harbour, which is to cost some 4,000,000 dollars. It will be built on the site of the old Hastings mill.

THE scheme for a ship canal between Newcastle and Carlisle is being resuscitated by Mr. J. Minns, of Carlisle. The cost of the project is estimated at a quarter of a million sterling.

IT is estimated that the schemes for providing Saskatoon, Regina, Moose Jaw, and Swift Current with natural gas from the gas fields of Alberta, Canada, will cost some 17,000,000 dollars.

WITH the assistance of capital provided from Boston, to the extent of 9,000,000 dollars, it is proposed to build a 90ft. dam across the North Saskatchewan River, and thus develop 75,000 horse-power.

TWO new services from Brindisi to the Far East are to be started on September 8th by the Lloyd Triestino Navigation Company. One will make the passage to Shanghai in thirty-one days and the other in twenty-six days.

WE learn that the Spanish Government is considering the building of a large experimental tank at Madrid, which will probably have the same dimensions as the new tank at Rome and will be specially suitable for high-speed work.

THE Institution of Petroleum Technologists has awarded to Dr. H. R. Lang a fellowship for the purpose of continuing his researches on the determination of the variation of the specific heat of typical crude oil with temperature, &c.

THE annual Conference of the National Smoke Abatement Society will be held at Leicester on September 26th, 27th and 28th. A programme of exceptional interest is expected to ensure the presence of many members and municipal delegates.

THE plant of Torbanite Products, Ltd., at New Glasgow, Nova Scotia, has recently been put in commission and promises to be one of the large industries of the maritime provinces of Canada. It is concerned with the extraction of oil from local deposits.

THE estimates for the construction of a bridge across Halifax Harbour, Nova Scotia, from Halifax to Dartmouth, on the North Shore, show that a suspension bridge could be built for 2,405,300 dollars, while a cantilever bridge would cost 2,547,480 dollars.

PLANS have been completed for the erection of a high-level bridge over the Ottawa River from Hawkesbury, Ont., to Greenville, Que., at a cost of 400,000 dollars. The span will be 400ft. long and the engineers estimate that the work will take about a year. The new span will be the first bridge to be erected between Ottawa and Montreal, with the exception of a short span at St. Anne's.

THE exhibition of works submitted for this year's Royal Society of Arts Competition of Industrial Designs was opened to the public on August 2nd at the Imperial Institute, South Kensington, and will remain open till the end of the month. The Exhibition is being held in the Exhibition Pavilion of the Institute (East Entrance), and is open every weekday from 10 a.m. to 5 p.m., and on Sundays from 2.30 p.m. to 6 p.m.

IT is announced that the United States Government helium production plant at Soney, near Amarillo, Texas, produced during May the largest quantity of helium ever turned out in one month by any helium plant. During the month the plant produced 1,230,350 cubic feet of gas, containing 97·93 per cent., or 1,204,900 cubic feet, of the element helium. The operating costs, per 1000 cubic feet of helium produced, were, it is stated, the lowest on record, and far below any cost figures deemed attainable by specialists in helium production a few years ago. The month also saw the completion, testing and preliminary operation of the second separation unit of the plant.

OWING to the greatly increased importance now assumed by the British Empire Exhibition to be held at Buenos Aires in March and April, 1931, the Government has decided to treble the sum to be expended on its official participation in the Exhibition. This increase will allow a considerable part of the British Government exhibits now being shown in the Antwerp Exhibition to be sent out and adequately displayed at Buenos Aires. The management of the Buenos Aires Exhibition has placed one of the finest buildings in its grounds at the disposal of the British Government, and the arrangement of the exhibits will be in the hands of the Department of Overseas Trade.

THE Council of the City and Guilds of London Institute have conferred the distinction of Fellow of the Institute—F.C.G.I.—upon the following:—Mr. F. M. Denton, Fellow, American I.E.E.; Mr. A. H. Dykes, M. Inst. C.E., M.I.E.E., M. Cons. E.; Mr. W. M. Heller, B.Sc. (London); Mr. E. M. Rich, B.Sc. (London), F.C.S.; and Mr. F. F. Renwick, F.I.C. The Fellowship is conferred by the Council upon those who, having obtained the Associateship of the Institute and spent at least five years in actual practice, produce evidence of having done some original and valuable research work, or of having otherwise contributed to the advancement of the industry in which they are engaged.

ROTORS FOR LARGE ALTERNATING-CURRENT GENERATORS

THE ALLGEMEINE ELEKTRICITATS GESELLSCHAFT, BERLIN, ENGINEERS

(*For description see page* 144.)

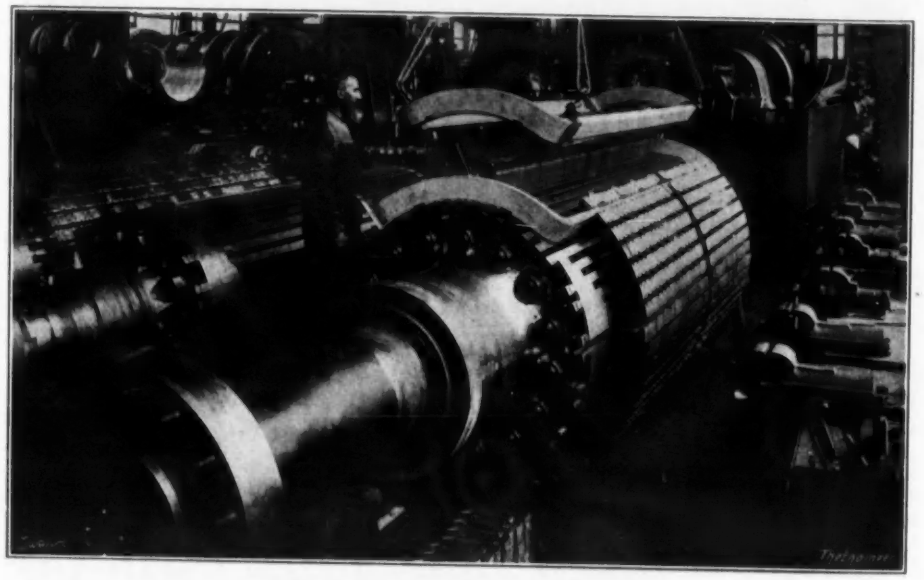


FIG. 6—INSERTION OF COILS IN ROTOR

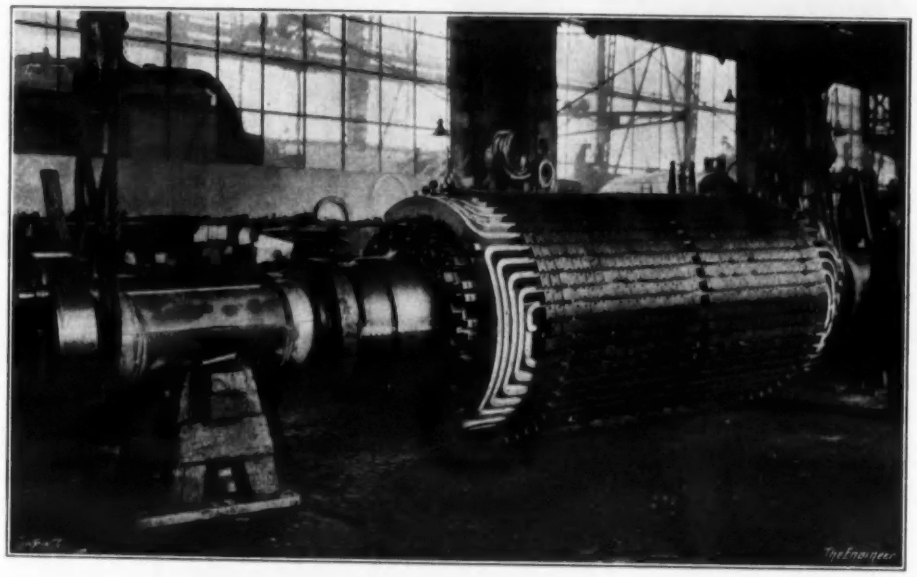


FIG. 7—ROTOR WITH WINDINGS AND TEETH IN POSITION

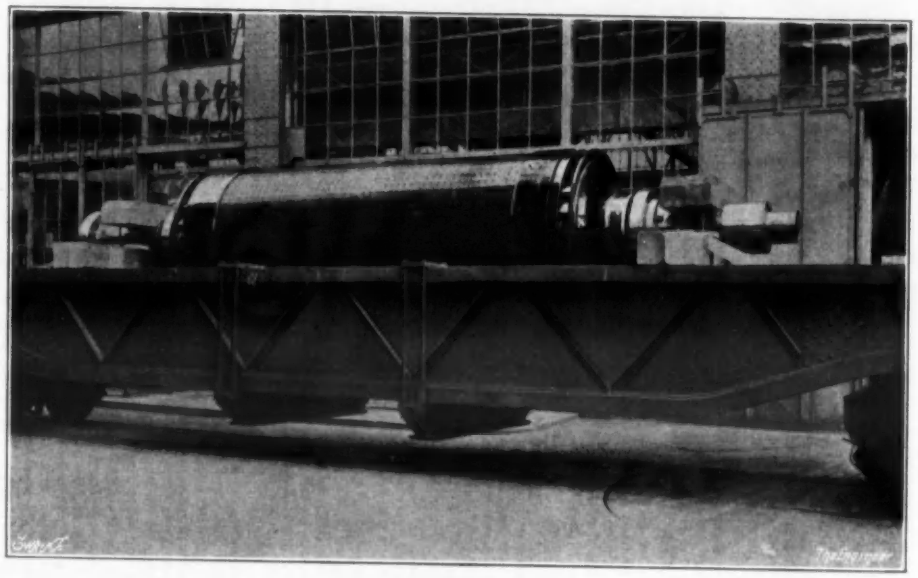


FIG. 8—FINISHED ROTOR

FIG. 9—TESTING A ROTOR FORGING FOR SOUNDNESS

The Engineer
Annual Subscription Rates
(including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below :—

BRITISH ISLES	£3	5	0	
CANADA	£3	3	0	Thick Paper edition.
	£2	18	6	Thin Paper edition.
ABROAD	£3	7	6	Thick Paper edition.
(except Canada)	£3	3	0	Thin Paper edition.

AFRICA	Central News Agency. All Branches
* £3 7s. 6d.	CAPE TOWN : Wm. Dawson and Sons, Ltd.,
† £3 3s. 0d.	29–31, Long-street (Box 489)
	JOHANNESBURG : C. Juta and Co.
ARGENTINE ..	BUENOS AIRES : Mitchell's Book Store, 576,
* £3 7s. 6d.	Cangallo
† £3 3s. 0d.	
AUSTRALIA ..	Gordon and Gotch (Australasia), Ltd. All
* £3 7s. 6d.	Branches
† £3 3s. 0d.	MELBOURNE : Robertson and Mullens,
	Elizabeth-street
BELGIUM ..	BRUXELLES : W. H. Smith and Son, 78–80,
* Fr. 590	Rue du Marché-aux-Herbes
† Fr. 550	
CANADA	American News Company, Ltd. All Branches
* $15·25	MONTREAL : Gordon and Gotch, Ltd., 334,
† $14·25	Notre Dame-street, W.
	TORONTO : Wm. Dawson and Sons, Ltd., 87,
	Queen-street East
	TORONTO : Gordon and Gotch, Ltd., 81,
	Queen-street West
CEYLON	COLOMBO : Wijayartna and Co.
* Rs. 44·5	
† Rs. 41·5	
CHINA	HONG KONG : Kelly and Walsh, Ltd.
* $37	SHANGHAI : Kelly and Walsh, Ltd.
† $34·5	
EGYPT	CAIRO : Express Book and Stationery Store,
* £3 7s. 6d. (Pt. 330)	9, Chareh Maghrabi
† £3 3s. 0d. (Pt. 308)	
FINLAND ..	HELSINGFORS : Akademiska Bokhandeln,
* M. 650	Alexandersgatan, 7
† M. 605	
FRANCE	PARIS : Boyveau and Chevillet, Rue de la
* Fr. 418	Banque, 22
† Fr. 390	PARIS : Librairie Berger-Leverault, 229, Bld.
	St. Germain
	PARIS : Brentano's, 37, Av. de l'Opera
	PARIS : Dunod, 92, Rue Bonaparte
	PARIS : W. H. Smith and Son, 248, Rue de
	Rivoli
GERMANY ..	BERLIN–LICHTERFELDE–WEST : H. Her-
* R. mks. 70·00	manns, Dahlemer Strasse 64 A
† R. mks. 65·00	WESTERN GERMANY : Fritz Rehfus, Blumen-
	thalstrasse 10, Cologne
	LEIPZIG : K. W. Hiersemann, Konigstrasse 29
HOLLAND ..	ROTTERDAM : Hector's Boekhandel, Noord-
* Fl. 41·00 ..	blaak 59
† Fl. 38·00	ROTTERDAM : Techn. Boekhandel, "Plan C,"
	Gelderschestraat 4
INDIA	BOMBAY : Thacker and Co., Ltd.
* Rs. 45	CALCUTTA Thacker, Spink and Co.
† Rs. 42	
ITALY	MILAN : Ulrico Hoepli
* Lire 300	ROME : Maglioni and Strini, 307, Corso
† Lire 280	ROME : Fratelli Treves, Corso Umberto 1, 174
	ROME : Fratelli Bocca
	TURIN : Rosenberg and Sellier, v. Maria
	Vittoria 18, and their Branches at Naples
	and Rome
JAPAN	Maruzen Co. All Branches
* £3 7s. 6d.	
† £3 3s. 0d.	
JAMAICA	KINGSTON : Educational Supply Co.
* £3 7s. 6d.	
† £3 3s. 0d.	
NEW ZEALAND	AUCKLAND : Whitcombe and Tombs, Ltd.
* £3 7s. 6d.	Gordon and Gotch, Ltd. All Branches
† £3 3s. 0d.	NAPIER : J. Wilson Craig and Co.
RUSSIA	LENINGRAD : Methdunarodnaya Kniga, Pros-
* £3 7s. 6d.	pect Volodarsky, 53 A
† £3 3s. 0d.	MOSCOW : "Litisdat," Kousnetsky Most, 5-15
STRAITS SETTLEMENTS	—SINGAPORE : Kelly and Walsh,
* $29·25	Ltd.
† $27·25	
SWEDEN	STOCKHOLM : A/B Wennergrens Journal-
* Kr. 61·00	expedition, Stockholm 1
† Kr. 57·00	STOCKHOLM : A/B C. E. Fritzes Kungl.,
	Hofbokhandel, Fredsgatan, 2
SWITZERLAND	BERNE : Joh. William De Groot, Laupenstr. 5
* Fr. 85·20	ZURICH : Rosa Leibowicz, 4, Ankerstr.
† Fr. 79·50	
UNITED STATES	International News Co., 131, Varick-street,
OF AMERICA	New York, N.Y., and all Branches
* $16·40	Entered as second-class matter at the Post Office,
† $15·25	New York, N.Y., December 12th, 1896, under the
	Act of March 3rd, 1879 (Section 397, P.L. & R.)

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch —minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 28, Essex-street, Strand, London, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Tel.: Central 6565 (8 Lines).

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, August 8th, 1930.

	PAGE
A SEVEN-DAY JOURNAL	137
THE PROTECTION OF ALTERNATING-CURRENT GENERATORS. No. I. (Illus.)	138
RAND WATER BOARD : ANNUAL REPORT	139
A NEWSPRINT MILL IN NOVA SCOTIA. (Illus.)	140
LETTERS TO THE EDITOR— Foreign Tongues	143
62,500-kVA TURBO-GENERATORS AT THE GOLDENBERG POWER STATION, GERMANY. (Illus.)	144
AMERICAN ENGINEERING NEWS	145
ELECTRIC SCOREBOARDS AT WIMBLEDON. (Illus.)	145
RAILWAY AND ROAD MATTERS	147
NOTES AND MEMORANDA	147
MISCELLANEA	147
LEADING ARTICLES— Locomotive No. 10,000	149
Wages and Prices	149
ENGINEERING DEGREE COURSES : SUGGESTED MODIFICATIONS	150
OBITUARY—E. S. G. Rees	151
SIXTY YEARS AGO	151
BOOKS RECEIVED	151
TROLLEY OMNIBUSES. (Illus.)	152
A MULTI-LANGUAGE INTERPRETATION SYSTEM. (Illus.)	154
THE PERFORMANCE OF TWO VESSELS WITH ELECTRIC TRANSMISSION GEAR. (Illus.)	154
SOUTH AFRICAN ENGINEERING NOTES	156
PROVINCIAL LETTERS— The Midlands and Staffordshire	157
Lancashire	157
Sheffield	158
North of England	158
Scotland	158
Wales and Adjoining Counties	159
PERSONAL AND BUSINESS ANNOUNCEMENTS	159
CONTRACTS	159
CATALOGUES	159
CURRENT PRICES FOR METALS AND FUELS	160
FRENCH ENGINEERING NOTES	161
BRITISH PATENT SPECIFICATIONS. (Illus.)	161
FORTHCOMING ENGAGEMENTS	162

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts ; correspondents are therefore requested to keep copies.*

DEATH.

ON July 31st, 1930, at 16, Windsor-road, Forest Gate, London, E. 7, GEORGE CHARLES IRWIN, M.I. Mech. E., managing director of S. H. Johnson and Co., Ltd., Engineering Works, Stratford, E. 15.

THE ENGINEER.

VOL. CL No. 3891

AUGUST 8, 1930.

Locomotive No. 10,000.

LAST week, Mr. H. N. Gresley's high-pressure locomotive, No. 10,000, was put on the London and Edinburgh service, taking the 10 a.m. non-stop from King's Cross. To haul the crack train of the day is the highest distinction to which any locomotive may aspire, and we take it that "No. 10,000" would not find herself in that proud position had she not already justified herself by her works in the eyes of her designer. As a matter of fact, she has been running in varied service in the North for some months, and for the past few weeks has been hauling express passenger trains between York and Edinburgh. In all, she has now run some 11,000 miles, and although she required, as might be expected, a few preliminary adjustments, they were readily made, and her performance can be regarded as very satisfactory. The major cause of anxiety was the boiler. Prophets who had had experience with water tubes in locomotive practice were confident that in a short time the tubes would fur up. That has not happened. The arrangement adopted—see THE ENGINEER, January 3rd, 1930—for causing the deposition of scale-making material in the forward part of the steam drum has proved quite effective, and the scaling of the tubes is negligible. Of course, the water in the North is better than that in the South, and the effect of the latter will be watched with interest for the next few weeks. But now that the use of water softening plants is becoming a more common practice on railways, scaling is a less serious problem than it was in the past. If this engine justifies her designer and builders in other respects, it may be taken that the fear of scaling will not be allowed to stand in the way of the employment of a water-tube boiler.

During the World Power Congress in Berlin an exhibition of locomotives was staged by the State Railways Company. At it could be seen, not only many standard German types, but several of the most recent inventions for the use of exceptionally high pressures. It is a pity that the L. and N.E.R. engine could not appear beside them. Her clean lines, unencumbered by a multitude of external accessories, could not have failed to impress the observer by contrast with the overburdened German products, as much as the simplicity of the mechanical arrangements must have appealed to the expert. The engineers of British railways have always prided themselves on the general features of design and the handsomeness of their engines. In this respect No. 10,000, whilst of necessity she differs from standard design, carries on the old tradition and possesses that air of dignity which is found in all great British locomotives. There is probably more in this cleanness of lines than—literally—meets the eye. Our knowledge of the air resistance of rapidly moving bodies is increasing, and the more we learn the more we appreciate the necessity of removing external excrescences and objects behind which air turbulence may occur. In Mr. Gresley's engine the air has a free run over a remarkably smooth exterior, and no doubt head resistance is thereby reduced. But apart from these external features, the engine is notable in that it has not jumped to those extreme pressures which have been experimentally adopted upon the Continent. What is the most economical pressure to use in locomotive practice has not yet been decided, but in adopting the comparatively moderate boiler pressure of 450 lb. Mr. Gresley has, in all probability, gone far enough to secure a useful gain in fuel economy without running into very high capital and maintenance costs. People who are not familiar with railway practice are rather apt to overrate the value of fuel economy. On British railways, which still buy coal fairly cheaply, the fuel bill is in the neighbourhood of not more than 7 to 8 per cent. of the total expenditure of the railway. The saving of a fraction of it, whilst it may be a big item in itself, is therefore but a small one by comparison with the vast sums involved. Furthermore, it is very readily lost. To begin with, the higher capital cost of the locomotive runs away with a great deal of the advantage. Let us assume the fairly reasonable figure of 1000 tons consumed by a given engine in a year, and that the cost of that coal is £1000. A 20 per cent. improvement in fuel economy will then only effect a saving of £200 per annum. But any of these modern high-pressure engines will cost many hundred pounds sterling more than a standard type engine for the same work, so that many years must pass before the additional capital expenditure has been paid off. Then, with every additional complication, there is an added danger of failure which entails not only greater maintenance costs, but, what may be even worse, takes the engine off the road for longer periods. It is such reasons as these that have caused the conservatism for which British railways are sometimes blamed. The engineers and traffic managers have always held—and quite rightly—that reliability must be the first consideration, and as, taking all things into consideration, a simple engine is more trustworthy, and less likely to spend long hours in the running sheds and shops than a complicated and very high-pressure engine, it has been preferred.

We think we may take it that no chief mechanical engineer likes high pressures ; he would rather have low or moderate pressures, and he only goes into higher figures so as to secure greater economy. In making a moderate advance—doubling instead of quintupling standard pressure—Mr. Gresley has taken a prudent course. We must wait until definite figures are available before the gain in thermal efficiency can be ascertained, but we may be quite confident even now that his locomotive, with its Yarrow-Gresley boiler, presents less features which are likely to increase the cost of maintenance or augment the possibilities of breakdown than most of the foreign designs which we have seen. We are confident that in this thoroughly British design we have one of the most practical solutions of the high-pressure locomotive problem that has yet been advanced.

Wages and Prices.

THE professional economist differs from the railway-carriage economist in that whilst the latter looks at one aspect of a problem—generally that in which he is directly and personally interested—the former sees it from a score of standpoints. If there is a trade depression, he wanders happily amongst the intricacies of the gold standard, the wool-clip, the bank-rate, the malign influence of the falling market, the effect of inflation and deflation—between which his hearers distinguish with uncertainty—and a score of cognate subjects, and

never allows himself to be pinned down to a single cause of the complaint or a single cure. He suffers from an embarrassment of knowledge. The politician economist is far less familiar than the professed economist with the intricacies of the subject, but since his views are all seen through glasses tinted with the party shade, his opinions come to us in an atmosphere of suspicion; we are never sure that they are inspired only by a single-hearted desire to clear up a difficulty, and that the wish to give the opposite party a back-hander has not influenced them. Hence, it comes about that since we can look neither to the experts for lucid and practicable advice, nor to the politicians for impartial action, we are constrained to ask the patient himself what is the cause of his complaint and what manner of cure he prescribes for it.

If we adopt this course and invite employers of labour to prescribe a medicine for the almost world-wide industrial depression, they tell us that a readjustment of wages is needed. In the United States, where for a time it was held that high wages were the proximate cause of great industry, opinions are changing with American rapidity. Now that the boom has come to a rapid end, observers are beginning to perceive that the cart had been put before the horse; industry was not flourishing because wages were high, but wages were high because industry flourished. With the coming of a slump, employers are revising their views, and steps are being taken to reduce wages or to found them upon a more reasonable basis. In Germany, which has always held conservative views upon the remuneration of labour, an effort is being made on scientific principles to bring wages down, whilst in other parts of the Continent they have never been allowed to rise, generally, to an excessive height. In this country, under political influence, the total cost of labour to industry has reached a figure which has hampered our efforts towards recovery. Whilst wages in some trades are inequitably low, they are in others absurdly high, but to both have to be added taxation for social services which bears very severely upon all branches of industry. Now of all countries in the world, Great Britain is in the greatest need of low costs of production. To her, overseas trade is an absolute necessity; she cannot exist without it. She must therefore be able to meet competition on a price basis. The advantage which she once enjoyed from the superiority of her products has gone in a great many trades, or has been discounted by the fact that the purchaser no longer desires a guarantee of longevity with the goods he buys. No longer can we salve our wounds with the "flattering unction" that no nation in the world turns out such fine engineering products as we do. A few things we may sell on quality, but the majority by far has to be sold on price. Even within our own borders we are confronted with that fact, and in order to defend our home market against cheaper foreign importations have had to adopt a policy of safeguarding. But though that policy may help us at home, it cannot aid us in neutral markets, unless, as some hope, it leads to a very material reduction of cost through an increase of output. But that brings us back to the same point that reduction of selling price is the object at which we have to aim. And here let us quote a passage from a lecture which Mr. Henry Clay delivered before the Royal Institution in June last. It runs thus: "There is evidence, however, that the capacity of industry to adjust itself to a lower price level is less than before the war; and, generally, that industry has grown more rigid and less adaptable at a time when the need for elasticity and readjustment is greater than ever. This may be illustrated by comparing the movement of prices in general with wages; while wholesale prices have fallen 25 per cent., wages have fallen only $1\frac{3}{4}$ per cent. With wages may be considered social services, the cost of which has increased while prices have been falling; no attempt has been made to adjust rates of benefit and pensions to the reduction in the cost of living. Again, debt charges remain on the 1924, or even on the pre-1920, level, where they have not been reduced by liquidation or reconstruction. Industry, therefore, gets little assistance from labour or the Government in its attempt to bring its costs down in accordance with the general reduction in prices, and the process of rationalisation, in which it is now engaged, is the last attempt to reduce costs, already considerably reduced, without such assistance."

If two curves be laid down, one showing the rate of increase of weekly wages during the past fifty years and another representing the cost of the necessities of decent existence, it will be found that the lines diverge. At one time, if we go far enough back, they crossed, wages were below the line of decent existence, but fifty years ago that point was passed, and the line of wages rose above the line of necessary expenditure. After the war, both lines turned upwards rapidly, but in many occupations there is now a large surplus over the decent existence margin. It is indicated by Mr. Clay's figures, which show that whilst wholesale prices have fallen by 25 per cent., wages have only fallen by $1\frac{3}{4}$ per cent. Much as we may desire to see labour enjoying a good margin for recreation, the improvement of home conditions, and the purchase of varied amenities, we are forced by the economic conditions to ask if the divergence between the lines is not too great. For it must not be forgotten that whilst those who are regularly employed enjoy the surplus, those who are out of employment are close to or even below the line of decent existence. Would it not be better to decrease the incomes of some, if thereby more could be employed? That is a question which Labour itself may be invited to consider.

Engineering Degree Courses: Suggested Modifications.

By W. NELSON ELGOOD, M.C., B.Sc., I.E.S. (Retd.).

PRACTISING engineers are generally agreed that workshop training should precede a university engineering course. They maintain that preliminary practical training is not only necessary for educational purposes, but for mental and moral development. The necessity of a young man beginning a university course with a sense of responsibility and the mental means of grasping the be-all and the end-all of a technical course is obvious to them. Periodically articles appear in both the technical and the popular Press advocating this preliminary practical training, but the number of parents who follow the advice offered is negligible. The action of parents in overlooking or ignoring this advice is due to a desire to complete the so-called education of their sons as soon as possible.

To understand this action we must analyse the psychological aspect of the whole case. When a son reaches the age of eighteen, the father is contemplating retirement from business and, accordingly, is anxious to complete as early as possible his commitments for the education of his son. These commitments are heavy and are probably preventing him from building up the capital required for his necessaries and comforts in retirement. He is prepared, perhaps, to assist his son after graduation by making him a small allowance for a few years, but the expensive part of his education must cease as early as possible. It is not necessary to labour this point further, but this factor does govern the behaviour of parents during the present condition of society. The practising engineer must bow his head to the seeming waywardness of parents.

We must recognise that the engineering courses offered by universities must be for young men just leaving school. The man who has already passed through workshops must follow the same course as his less fortunate friend. Both must obtain the desired benefits and at the end be mentally and educationally fit to follow their respective paths. The university courses must be such that they are suitable for the undergraduate who has just left school and will so prepare him that he will be of immediate use to an employer, even in the position of a pupil, and at the same time they must be of equivalent use to the undergraduate with practical training and prepare him in such a way that he can take up a professional post after graduating.

What are the requirements of a potential employer in regard to qualities and to education possessed by a graduate he contemplates employing? He would like to anticipate that such an employee (1) has a love for the profession he is entering; (2) has a sound knowledge of mathematics, applied mechanics and the other sciences embodied in the branch of engineering he is proposing to follow; (3) has an appreciation of his coming responsibilities; (4) has a workable technical vocabulary; (5) has a knowledge of the functions of the more common engineering designs and projects; (6) appreciates the general economics of the design of machines, structures and projects; (7) appreciates the work undertaken by the different skilled tradesmen; (8) can, by observation, spot the difference between good and bad work, and (9) while not being able to handle and operate skilfully, understands the use and operation of the more common tools, machinery and plant.

How can a university undertake to meet these nine requirements of potential employers? It must be remembered that pass and honours courses should not exceed in length three and four years, and that the number of subjects that can be included is limited. A large amount of harm can result from the teaching of too many disconnected subjects. As far as possible all subjects should be related to each other, and during the whole course the student should advance harmoniously from year to year without violent jumps to subjects bearing little or no relation to others.

In general it is not in the list of subjects taught that university courses can be criticised. The majority of courses are well organised, but they give results, that, although good, are not what are required by potential employers. Constructive criticism of the courses leads one to realise that it is mainly in details that modifications are required.

From the foregoing it is seen that the following factors must be taken into consideration by Boards of Studies framing courses:—(1) All subjects must be inter-related as far as possible; (2) in each subject the student must grasp the essentials and must see without difficulty how these essentials are applied in practice; (3) during the course the student's love for the engineering profession must increase progressively and his interest must never be allowed to wane; (4) laboratory and drawing-office work must be undertaken in conjunction with the theories explained in the lectures and must be so organised that students work independently and obtain every opportunity to increase their powers of observation, deduction and induction, and (5) workshop practice should be included in the carriculum, not for the purpose of attempting to turn out skilled tradesmen or for eliminating the necessity of a student passing through an industrial workshop as a pupil or an apprentice, but for the purpose of allowing students to become acquainted with the different tools and machines used in modern engineering practice, and to appreciate good workmanship. Instructors in the workshops should point out to students that they are not being trained to become skilled carpenters, fitters or smiths, but are there to study the different tools, to grasp the methods of operation, to obtain a love for good workmanship, to pick up shop technique, to get rid of "hand awkwardness" and to learn how the different shops are laid out and equipped.

Experience has shown that mentally the average engineering student is a complex being. He appears to be differently constituted from his friends in the medical, pure science, arts, and law departments. He can become obstinate if the lectures are heavy and dull, and if there is too much overlapping or repetition. He appreciates good lecturing, and if the course he is following flows forward smoothly he will stick it and get through smilingly. If the flow is not smooth, he will mulishly stick in his feet and refuse to budge. The writer knows of one course that was ruined by the attitude of the students. In this case mathematics was taught by a lecturer in another department. This lecturer, who was not under the head of the engineering department, could not find the time to offer a special course for engineers, and so fitted them into his arts and pure science classes, irrespective of whether they were suitable or not. There was a certain amount of overlapping with applied mechanics and a certain amount of instruction in branches of the subject not included in the engineering curriculum. The feelings of the engineering students can be understood. Loss of time resulted and the percentage of passes in the examinations was small.

Enough emphasis cannot be laid on the importance of preventing the interest of students from flagging. Mathematics and applied mechanics should, as far as possible, be taught by the same lecturers each year to prevent overlapping. These lecturers must be under the head of the engineering department. Work in the drawing-office should be based on the subject-matter of the technical and descriptive lectures. The writer has found that it adds interest to the work if actual specifications advertised in a technical journal be obtained and designs executed in accordance therewith. The necessary small amount of money required for fees or deposit can usually be found without difficulty. In this case each student keeps a model file of correspondence on the subject, letters being drafted by each student—these, of course are not sent—and copies made of model replies compiled or perhaps received by the lecturer. Laboratory work should also be based on the theories explained in the lectures. The plant and equipment of the laboratories should be so selected and arranged that students can work individually or in small gangs, and that each student works continuously. The pernicious habit of students working in large gangs, where one or two conscientious members do all the work and the remainder merely copy the results in their notebooks, must be eliminated. Students must be urged to make their own observations and should, where possible, tabulate their results on standard commercial forms. Original observations of students should be fully discussed with them and encouraged in other ways. Commercial, scientific and investigatory testing should be separated.

During the whole of the degree course descriptive lectures should be delivered by competent engineers with a sympathetic understanding of the mental capabilities of the students. The writer organised the following course of lectures for a four years' civil engineering course. One one-hour lecture was delivered each week during the winter and spring terms, and excursions to appropriate works in progress and to completed works were made on the Saturday mornings the organised games made available. The results obtained from these lectures were very satisfactory. It was found that students unconsciously selected the branch of engineering for

which they were most suited, and by becoming acquainted with the actual problems met in practice, read more understandingly the technical journals provided in the reading room. The programme of lectures was, as mentioned above, for a four years' course. All students attended each lecture. This programme was as follows :—

	Winter term.	Spring term.
1924–9125 ..	Descriptive astronomy ..	Bridges
1925–1926 ..	Roads	Railways
1926–1927 ..	Harbours and docks ..	Water supply
1927–1928 ..	Sanitation	Water power
1928–1929 ..	Descriptive astronomy ..	Bridges
&c.		

During the summer term, in place of these lectures, students examined projects and prepared individual reports thereon. During the final year these reports were very complete and included simple specifications and estimates of costs. While engaged with these projects and descriptive lectures, students kept charts of the market prices of materials and prepared from their descriptive lectures and from information collected on visits schedules of rates.

Further interest can be stimulated in students by supplying comfortable reading rooms stocked with reference works, text-books, "Proceedings" of institutions and manufacturers' catalogues, and a museum furnished with fully described models and exhibits of interest.

The writer has found that there are always firms and engineers willing to take students under certain conditions during a part of the long summer vacation. He has always stipulated that these students should work during the customary hours and should be given no responsibility. In addition, he has also stipulated that no wages should be paid. It is argued that employment of this nature is solely obtained for the purpose of allowing a student to realise the meaning of a day's work. A large number of students have been found employment of this nature, and no complaint of any nature has been received from an employer. This type of employment should not be confused with the paid employment obtained by a student who is attempting to "earn his fees."

In attempting to reach an ideal, enthusiasm may run away with common sense and the required practical solutions may not be obtained. In considering an ideal engineering course for a university, one is inclined to fill the course with a variety of subjects involving more hours of lectures than is advisable for the average student. Under no circumstances must students become mentally tired by attending too many lectures in a day. Laboratory and practical work are always interesting and involve comparatively little mental effort on the part of students. The mental effort required to follow a delivered lecture is too well known by readers to require emphasis. It will be found that if the laboratories are left open whenever feasible outside the time-table hours, students will avail themselves of the opportunity of doing helpful work during their spare hours.

It is not permissible to criticise destructively the present courses of universities, for there is no doubt that good results are obtained, but if the requirements of potential employers are taken into consideration necessary modifications can be made with assured success. A university course should not be a "grind" to push students through their final examinations. It should be a preliminary part of their technical and professional training, and the lectures, laboratory work and workshop instruction should be organised with that end in view.

Obituary.

E. S. G. REES.

WE have to record with regret the death of Mr. E. S. G. Rees—whose name is widely known as the inventor of the "Roturbo" pump—which, as we briefly announced in our last issue, took place at his home at Oaken, near Wolverhampton, on Saturday, July 19th.

Edmund Scott Gustave Rees was born in Ghent on August 27th, 1861. His father was at the time managing a works in that city, but shortly after the son was born the family returned to England and proceeded to Manchester. Young Rees received his early education at private schools, and later studied at Owens College. In 1877, when he was sixteen years of age, he became a pupil at the works of what was then the Manchester, Sheffield, and Lincolnshire Railway. Six years later he entered the drawing-office of Beyer, Peacock and Co., and in 1886 he migrated to Wolverhampton in order to take service as draughtsman with Elwell, Parker and Co., Ltd., manufacturers of electrical machinery. In 1891, when the business carried on by that firm increased to such an extent that its scope had to be enlarged, a new company—the Electric Construction Company—was formed with increased capital, and Rees was retained on its staff. In 1893 Mr. Parker severed his connection with the Electric Construction Company in order to form, at Wolverhampton, a separate undertaking under the name of Thomas Parker, Ltd., and Rees joined forces with him, eventually, on Mr. Parker's resignation, becoming at first joint managing director and finally sole managing director. Subsequently, on the invention of the "Roturbo" pump, the name of the company was changed to that of the Rees Roturbo Manufacturing Company, Ltd., with Mr. Rees as managing director, a position which he held until some three years ago when he retired from active business, though he still retained a seat on the Board.

At a very early period of his life Rees was greatly interested in electrical matters, eagerly reading all the literature on the subject, and as quite a young man he became an inventor. In 1888 he took out a patent for an electricity meter, and in the next year a patent for magnetic cut-outs and another for quick-break switches. In 1890 he took out a further patent for what came to be known as the Oxford System of distribution by means of high-tension direct-current and rotary tranformers. In the following year he improved upon that system by the invention of remote-control magnetic switches, by means of which machinery in sub-stations could be operated from the central station. About this time, too, he did some work in connection with the Liverpool Overhead Railway. Later, he took out a patent for arc lamps and for other electrical apparatus. It would be quite impossible for us to attempt to give a full list of his inventions, the specifications of which would form a volume of large dimensions, for he was a prolific inventor, but mention must be made of two series of patents which were of outstanding importance.

Mr. Rees' early patents were concerned, as we have seen, with matters electrical. About the beginning of the present century, however, he turned his attention to centrifugal pumps and carried out a very large number of experiments with the object of discovering whether it was not possible to design a pump, the power to drive which would not vary appreciably with the head being pumped against, and consequently with the volume of water being dealt with. The result of his investigations was the introduction of the "Roturbo" pump, in which the characteristic of self-regulation was obtained by the embodiment in it of a pressure chamber. This pump, which was fully described in our issue of May 17th, 1907, has a power curve which is singularly flat over a very wide range of volume delivered, and was, we believe, the very first pump possessing practically complete self-regulation to be made. Its development led to the invention of condensers, air pumps, air compressors, &c., in which the leading features of the "Roturbo" pump were called to play a part. A great deal might be written, did space permit of it, regarding Mr. Rees' ingenuity in applying his discoveries in this direction to many and varied purposes.

Again, another long series of tests and experiments led to the discovery of what Mr. Rees described as "Propeller-Jet Marine Propulsion." He set himself to answer the following questions :—"Can the good features of propeller propulsion, jet propulsion, and twin reversing rudders be combined in one apparatus ?" and, if so, "Can the efficiency of the propeller be increased by that apparatus so that the speed of the boat be not reduced by the modification ?" He claimed to have answered those questions entirely in the affirmative by means of the device which was illustrated and described in our issue of May 1st, 1925. It was applied with marked success to craft of very different characters, including a dispatch boat for the Admiralty. One application was to a canal boat which has been in successful continuous service for the last five years or so. Only the depression in the shipbuilding industry which has been so lamentably in evidence during recent years, has, we understand, prevented this device from being more widely employed than it actually has been.

Mention must also be made of a further set of experiments which had extended over the last ten years or more, and which led up to the invention of what Mr. Rees termed the "Rotafoil" pump, and a form of screw pump. These two inventions, we are given to understand, he regarded as being the greatest work of his life. At the moment, however, as neither of them has, as yet, reached the stage of being put upon the market, we are precluded from saying much regarding them. We may explain, though, as regards the "Rotafoil," that the fact that there is a reduction of pressure on the upper surface of an aerofoil, has been applied to the design of the pump impeller in order to create a suction lift. The pump has an outside suction chamber and a central delivery. A small pump of this type which was under test at the works just before Mr. Rees' death, is said to have given results with which he was so fully satisfied as to be certain of its success.

As a man, Mr. Rees had a charming personality which secured for him a wide circle of friends. He was an adept at describing pieces of mechanism, so as to be readily understood even by the non-technical, often accompanying his explanations with lightning pencil sketches, in the production of which he was singularly proficient.

AN investigation to determine the possibility of producing a well-burned Portland cement clinker at a relatively low temperature, by the use of a small quantity of boric acid as flux, was begun several months ago by the U.S. Bureau of Standards. The preliminary results have been favourable enough, and it has been found that the refractive indices of the clinkers were also lowered by the addition of boric acid. It is held possible that some of the boric acid forms a solid solution with the silicate.

Sixty Years Ago.

IT is difficult at this date to recapture in just perspective all the details, personal and otherwise, which went to make the tragedy of the "Captain." We have on several occasions in this paragraph noted the animosity which, in years gone by, was commonly imported into discussions involving a difference of technical or scientific opinion. That spirit was particularly marked in the controversy to which the "Captain" gave rise, and its existence confuses us to-day in our endeavour to present an impartial picture of the merits of the case. It is popularly supposed that the "Captain," a steam-and-sail turret ship of 4272 tons, designed by Captain Coles and built by Laird Brothers, was forced by public clamour upon the Admiralty, which, guided by its Controller, Admiral Robinson, and its Chief Constructor, Mr. E. J. (Sir Edward) Reed, still clung obstinately to the broadside design of war vessel. That supposition is encouraged by the terms employed on the memorial tablet placed on the walls of St. Paul's Cathedral in memory of the 482 officers and men who lost their lives when the vessel capsized on the night of September 6th, 1870. "The 'Captain' was built in deference to public opinion expressed in Parliament and through other channels and in opposition to the views and opinions of the Controller and his department, and the evidence all tends to show that they generally disapproved of her construction." So says the monument quoting the finding of the official Court of Inquiry. Before the vessel was received from the contractors, the inscription continues, a grave departure from her original design had been committed, whereby her draught of water was increased about 2ft. and her freeboard diminished to a corresponding extent. Her stability proved to be dangerously small, combined with an area of sail which, in the circumstances, was excessive. "The Court deeply regrets," the inscription concludes, "that if these facts were duly known and appreciated, they were not communicated to the officer in command of the ship, or that, if otherwise, the ship was allowed to be employed in the ordinary service of the Fleet before they had been sufficiently ascertained by calculation and experiment." There is much in this official explanation of the disaster which excites our curiosity. Can we accept as true the picture which it conveys of an unwilling Admiralty dragged at the heels of an unofficial designer and a private firm of shipbuilders ? What was the "grave departure" made during the vessel's construction which led to her draught being increased by 2ft. ? Can we really believe that on the fatal night her Commander, Captain H. T. Burgoyne, V.C., was ignorant of the fact that the vessel's freeboard was only 6ft. and not 8ft., as originally intended ? Is it credible that her designer, Captain Coles, who was on board at the time and who was to be numbered among the lost, did not fully realise the effect which the reduced freeboard would have on the stability of the ship ? In our issue of August 12th, 1870, a month before the disaster occurred off Cape Finisterre, we published reports on the sailing and gunnery trials of the "Captain," and reprinted a letter from Mr. E. J. Reed, which had been published in *The Times* criticising the design of the ship. From these sources it would appear that the Admiralty and Mr. Reed, far from having the turret system forced upon them from outside, had themselves designed and produced several turret vessels before, or, contemporaneously, with Captain Coles. The "Captain" was, in fact, tried at sea against Mr. Reed's turret ship "Monarch," which was finished at about the same time. Admiral Robinson, according to Mr. Reed, had, since 1866, been strongly in favour of light draught turret ships, and in fulfilment of his wishes in the matter, Mr. Reed had designed not only the "Monarch," but the "Cerberus," "Magdala," "Devastation," "Thunderer," "Fury," and other turret ships. Admiral Robinson and Mr. Reed may have been opposed to Captain Coles' design of turret ship, but they were clearly not opposed to the turret ship principle in general. The report of the Court of Inquiry is also misleading in its suggestion of a concealed alteration in the design of the "Captain." Mr. Reed, in his letter, specifically referred to the change of freeboard from 8ft. to 6ft. He did not speak of it as a "grave departure." He described it in stronger terms as "an alarming blunder in calculation—the worst that I have ever known." A mistake of 800 or 900 tons had, he implied, been made in calculating the vessel's weight. In the light of these facts, all fully known at least a month before the disaster, the Admiralty cannot, it is clear, be acquitted of responsibility for sending the ship to sea in a dangerous condition, nor be allowed to pass the remote blame for the disaster on to the public. In fairness to the memory of Mr. Reed, it should be added that some time before the vessel foundered, he had ceased to be the Navy's Chief Constructor and had been succeeded by Mr. (Sir Nathaniel) Barnaby.

BOOKS RECEIVED.

Economic Conditions in Canada to May, 1930. Report by F. W. Field. London : His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. 6d. net.

Engineering Economics. Second edition. By T. H. Burnham. London : Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 10s. 6d. net.

The Air Annual of the British Empire, 1930. Edited by Squadron Leader C. G. Burge, O.B.E., A.R. Ae. S.I. London : Gale and Polden, Ltd., 2, Amen-corner, E.C. 4. Price 21s. net.

Economic Conditions in Italy. Report by E. C. Donaldson and H. C. A. Carpenter. London : His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. 6d. net.

Die Elektrizitätsgesetzgebung der Kulturländer der Erde. Vol. I., Deutschland ; Vol. II., Westeuropa ; Vol. III., Nord-und Osteuropa. Berlin : V.D.I. Verlag G.m.b.H., Dorotheenstrasse 40, N.W. 7.

Annali dei Lavori Pubblici (già Giornale del Genio Civile), Ministero dei Lavori Pubblici, Consiglio Superiore, Anno LXVIII., Fasc. No. 5. Maggio, 1930. Rome : Provveditorato Generale dello Stato, Libreria.

SINGLE-MOTOR TROLLEY OMNIBUS

THE ASSOCIATED EQUIPMENT CO., LTD., AND THE ENGLISH ELECTRIC CO., LTD., ENGINEERS

Trolley Omnibuses.

At the Southall works of the Associated Equipment Company, Ltd., we recently inspected a single motor trolley omnibus, which was about to be dispatched to Nottingham. In collaboration with the English Electric Company, the firm has put three vehicles of this type upon the market, having as their basis the A.E.C. "Regal" "Regent" four-wheel and "Renown" six-wheel chassis. The Associated Equipment Company is manufacturing the chassis and components, whilst the electrical equipment and bodies are being made by the English Electric Company, Ltd. The vehicle we inspected is designated model 663 T, and, as shown above, it is a double-decked, six-wheeled vehicle, the wheel base measuring 16ft. 6in. The seating capacity is sixty. The other two models are designated 661 T and 662 T. In both cases these are four-wheel vehicles, the wheel base in the former case measuring 15ft. 6¾in., and in the latter case 17ft., whilst the seating capacities are fifty-fifty-two and thirty-thirty-four respectively. The six-wheel vehicle shown in the illustration can also be supplied with a wheel base measuring 18ft. 7in. An exceptionally rigid frame is provided, the maximum section being 11in. deep in the case of the four-wheel vehicles and 11¼in. for the six-wheel model, and in order to eliminate distortion all the cross members are of tubular section. As shown in the drawing, Fig. 1, a "kick up" is provided to go over both the front and rear axle, the frame level under load being 1ft. 9in. or 1ft. 9½in., according to the model. A view of the six-wheel chassis, complete with the electrical equipment, is given in Fig. 2.

Foot-controlled internal expanding brakes are fitted on all the wheels and are operated by compressed air on the Westinghouse system, whilst a hand brake operates independent shoes on all the rear wheels. All the brakes are of the internal expanding type, with detachable liners working on hard, pressed-steel drums. For both brakes a single point adjustment is provided, and all brake shoes are interchangeable. If required, electric braking can be added. The Marles type of steering gear gives exceptionally easy control, whilst front springs of great length and flexibility afford good riding comfort. Hydraulic shock absorbers are fitted as standard in order to eliminate bouncing on bad roads. Extra-large roller bearings carry the front axle, which is of substantial design.

Tubular propeller shafts coupled by Spicer couplings transmit the power to the rear axles through self-aligning ball bearings mounted between the motor and rear axles, which are composed of single-piece steel forgings carrying the worm gearing in separate casings with exceptionally large oil capacity. The 3in. diameter axle shafts are composed of 100-ton steel, and are mounted on adjustable taper roller bearings. The differentials are of the bevel type, and of very heavy construction. In the forward axle at the rear end of the worm shaft of the six-wheel vehicles there is a third differential, which has been found to be necessary to get an equal drive through all four rear wheels. The question of the necessity for a third differential on six-wheel vehicles has often been discussed, and Mr. G. J. Rackham, of the Associated Equipment Company, has carried out experiments with a view to settling this question definitely. Should there be a difference of effective rolling radius of the tires, owing either to tire wear or difference of inflation pressure, the axle having the smallest radius tires will try to rotate faster than the other axle, and will thus have wheel slip, the other axle doing all the driving plus an over drive from the axle with the deflated tires. This, as the tests referred to have clearly shown, results in extra wear and increased rolling resistance. The experiments were carried out with tire pressure differences from 0 lb. to 40 lb., as it was found that a 40 lb. difference of tire pressure was the maximum that could be passed by casual inspection of the tires. The results in all cases were exactly proportional to the difference of effective tire radius, the tests being repeated a number of times for pressure variations of 5 lb., 10 lb., 15 lb., 20 lb., 25 lb., 30 lb., 35 lb., and 40 lb. per square inch. The third differential used was similar to that shown in Fig. 5, and it was so arranged that it could be locked and put out of operation. Counters were fitted to each of the road wheels, and it was found that with 40 lb. pressure variation the difference in the revolutions per mile was 10·5, or 99ft. slip per mile, these figures being exactly in accordance with the amount calculated from the effective tire radii. Rolling tests were then made with and without the differential with a 40 lb. pressure variation down a gradual hill. These tests were repeated a number of times for various tire pressures, so that average results might be obtained, and from the figures recorded increased rolling resistance was found to be 27 per cent. with 40 lb. tire pressure variation. Axle temperature tests were then made to get some measure of the extra work being done by the axle having the larger radius tires, the vehicle fully loaded being taken to the top of Belmont Moor, which is about a 7-mile climb, and with the differential working the temperature of both axles was then about 125 deg. Fah. A similar test was then made with the third differential locked, and it was found that the axle with the deflated tires had a temperature of 143 deg. Fah., whilst the temperature of the axle with the fully inflated tires was 212 deg. Fah.; in other words, the difference in axle temperature was 69 deg. Fah. and from these figures it is obvious that, in order to get an equal drive through all four rear wheels, the third differential is essential.

The torque blade of the six-wheel vehicle is made from chrome-vanadium spring steel, and is carried in robust cast brackets mounted in the centre of each of the axle casings. The blade has cylindrical ends and the forward end can oscillate and slide in its bearings, whilst the rear end is only capable of sliding. On the rear axle bogie there are two long and flexible springs to afford a maximum of riding comfort. The springs are carried in the centre of a heavy spring chair, which swings in gun-metal bushes in the bogie brackets, which are riveted to the frame and are stiffened by a 4in. tubular cross member brazed on to the brackets to resist torsion.

A single motor driving direct to the rear axles by means of a cardan shaft and Spicer coupling, is situated well forward on the chassis, to give free and unobstructed space for the body and the motor can be removed bodily through the front panel of the dash. The motor is of the box-frame, self-ventilated type, and is rated at 65 or 80 horse-power, as required. Wherever possible, lightweight metal has been used in the construction, in order to reduce the total weight of the motor to a minimum. Two large covers are fitted over the commutator to facilitate inspection and maintenance of the commutator and brush gear, which consists of four brush holders, each carrying a single brush. The armature bearings are of the roller type, and can easily be removed.

As in the control of railless vehicles, in addition to the application of the power and brakes, the driver is respon-

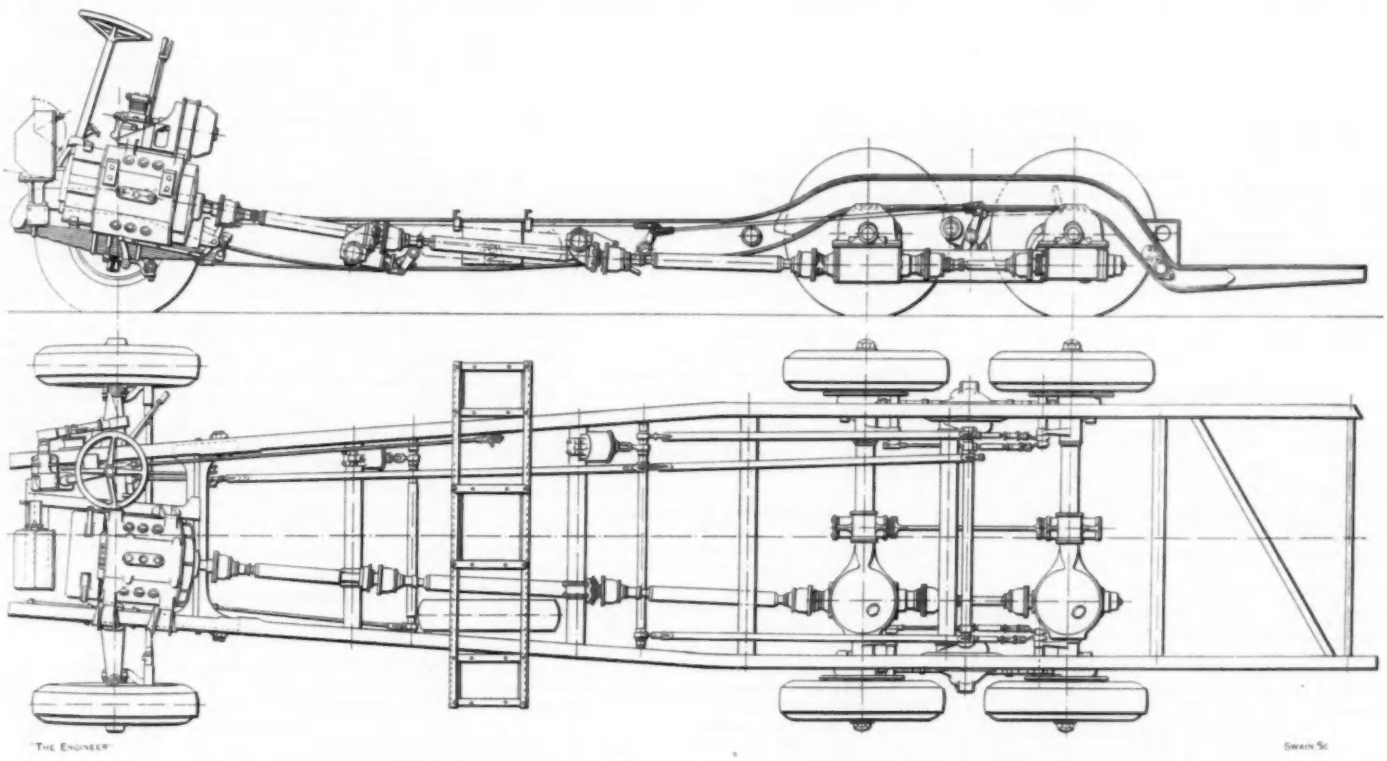


FIG. 1—ELEVATION AND PLAN OF CHASSIS OF TROLLEY OMNIBUS

sible for steering, it is very essential for all operating movements to be simple, and in the design of the English Electric Company's control gear simplicity of operation has been the keynote throughout, all power and brake applications being achieved merely by the use of two pedals and a hand brake lever. The control is of the solenoid-operated contactor type and is designed to meet the peculiar conditions which are met in railless traction. The essential parts of this control are :—(1) A master switch—see Fig. 4—which controls the operation of the contactors, ensuring that they are opened and closed in the correct sequence. The switch is of robust design, and is operated by foot pressure on a pedal, the leverages of which are so arranged that the effort required to be given to it by the driver is reduced to a minimum, and compares favourably with that necessary in the depression of the accelerator of a petrol motor vehicle. The current carried on the master switch is negligible and thus no arcing of any consequence can occur. The contact fingers, which are substantial and adjustable, are fitted with renewable tips. For single-motor control, which is adopted on all the Associated Equipment Company's vehicles, six operating notches are provided, and if field shunting is desired the sixth of these is used for that purpose. (2) A reverser is mounted in the same case as the master switch and interlocked with it in such a manner that the reverser can only be moved when the master switch is in the " off " position. The reverser,

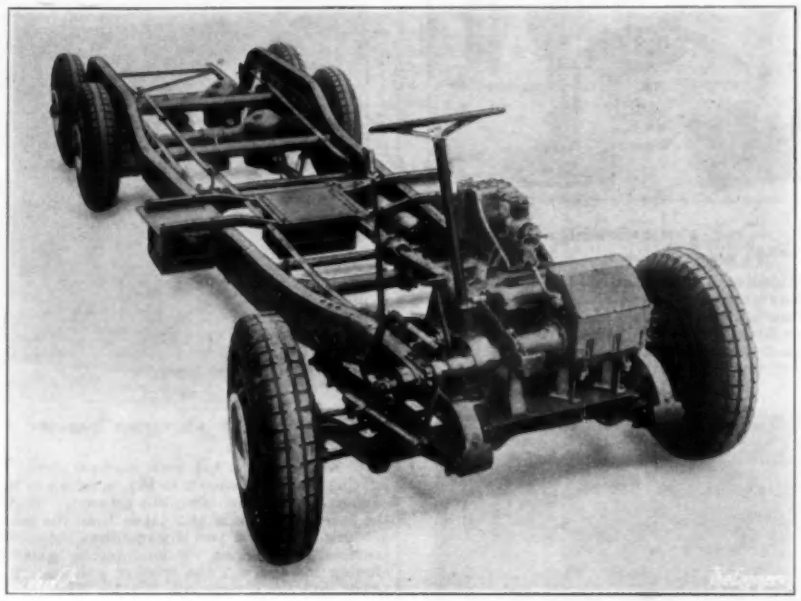


FIG. 2—CHASSIS AND ELECTRICAL EQUIPMENT

FIG. 3—DRIVER'S COMPARTMENT

which is hand-operated, cannot be thrown from the " forward " to " reverse " positions, or *vice versâ*, while power is being supplied to the motor. The combined master switch and reverser is situated near the front dash at the left front of the driver's seat when the " rule of the road " is the English one. The master switch and reverser are to be seen in Fig. 3. (3) A contactor panel, which consists of a number of solenoid-operated contactors mounted side by side in asbestos-lined steel case with removable cover. The contactors are of robust design, each being provided with its own blow-out device, while the arc chutes are easily removable and are of special grade of arc-resisting material. All the contactors, which are composed of die castings, are interchangeable, while the contact tips and auxiliary fingers are renewable. (4) Incorporated in the contactor group is a current limit relay, which gives automatic acceleration. When in circuit, and after the first two notches, it operates in the usual manner, the first and second notches being under the control of the driver, while subsequent notches are controlled entirely by the current limit relay, which is set to a predetermined value. After the driver has reached the second notch he can depress the master switch pedal down to its limit without any harmful effect on the electrical equipment. Automatic adjustment of the relay is given on the last full field notch by the bringing into circuit of an auxiliary relay coil, this adjustment being necessary when field shunting is used, owing to the rise in current value when moving from full field to shunt field conditions.

When required, rheostatic braking operated from the foot brake pedal, and involving the use of a special brake switch can be included. The pedal arrangement is such that the initial depression of the foot air brake pedal operates the brake switch, while subsequent depression of the pedal applies the air brake while still retaining rheostatic braking. As electric braking acts through the transmission, and as it is very unwise to put any undue strain on this vital part of the chassis, the English Electric Company's rheostatic braking system has been so graded that it acts in a capacity similar to that of a petrol engine, which, when in gear, will provide an adequate brake for coasting purposes downhill without any harmful effect on the cardan shafts, universal joints, or differential gears. By the use of this electric brake the life of the brake liners is materially lengthened, as they are only in use when the vehicle is being brought to a dead stop, and then only from a comparatively low speed. This brake is usually provided with two notch positions graduated so that the deceleration obtained does not cause discomfort to passengers. The rheostatic brake is interlocked with the main control, so that the main current is broken when the brake is applied and power and brake cannot be brought into use at the same time. As shown in the diagram of connections, Fig. 4, there are two circuit breakers, which are provided with simple means of adjustment. The starting resistances, which are mounted on the chassis, are of the jointless, unbreakable, non-rusting type, and are designed to withstand the maximum temperature to which they are likely to be subjected. The collector gear consists of two independent insulated trolleys arranged side by side, each complete with a trolley head and tapered trolley pole, which may have a length up to 20ft., so as to permit a vehicle to deviate from the centre of the overhead wires by approximately 13ft. on either side. For use in depôts a trailing skate for making contact with rails can be provided when required, and in that case a hand-operated change-over switch is included and is operated by the reverser key.

Special attention has been paid to the design of the body with a view to combining comfort and facility of entrance and exit with a high standard of artistic appearance. The seating layout gives comfortable knee room and the seats

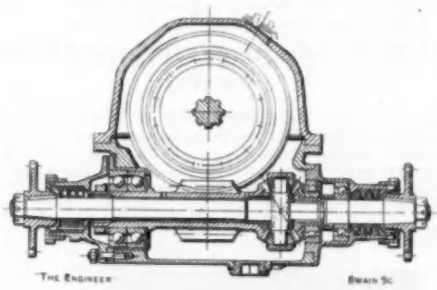


FIG. 5—THIRD DIFFERENTIAL

are of a spring-cushion type upholstered in moquette in the lower saloon and hand-buffed leather in the upper saloon of the double-deck vehicles. In both saloons ample ventilation arrangements are provided. On the lower deck air enters through the canopy of the driver's cab and can be regulated so that there is no draught. In the upper saloon two "hit-and-miss" ventilators are fitted in the front bulkhead. Four windows in the lower saloon are arranged to drop, and over each of them there is a glass louvre to prevent rain driving in when the window is slightly open ; in the upper saloon four windows are also arranged to drop.

The lighting system is of a concealed type and, with the exception of the step light, no lamps or fittings are visible, the lamps being placed behind hinged translucent panels which form part of the interior surface of the saloons, and the resulting illumination is such as to permit reading without strain and with a complete absence of glare. Special attention has also been paid to the reinforcement, so as to ensure that the body work may be rigid and

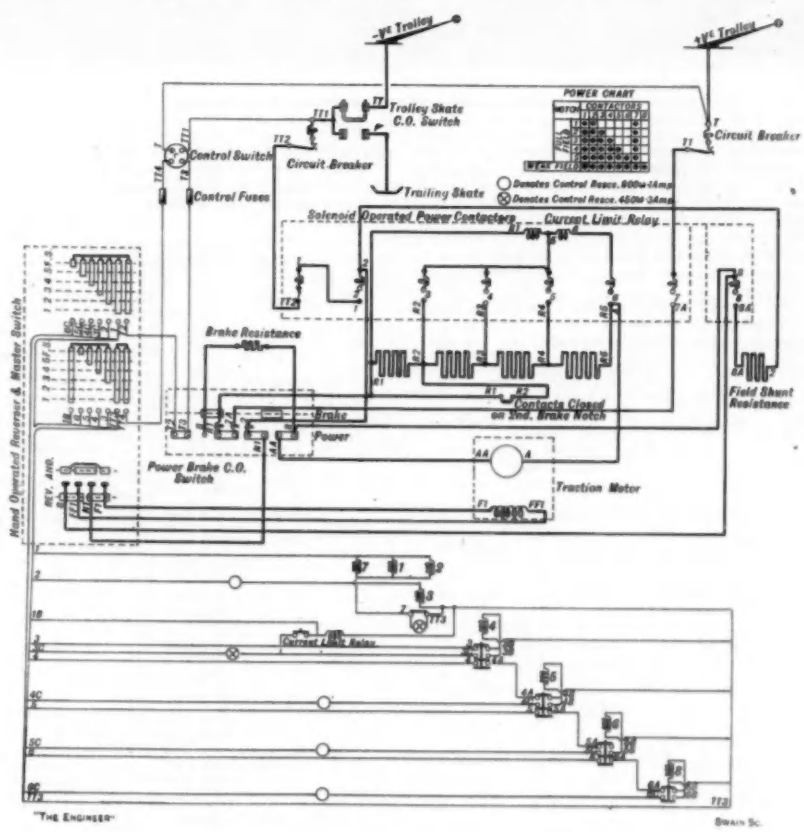


FIG. 4—DIAGRAM OF CONNECTIONS

capable of withstanding any stresses which may occur when the vehicles are running over bad roads. The side and end panels and the shaped corner panels are composed of aluminium, whilst the interior is finished with mahogany-faced panels below the windows and aluminium kicking plates.

The arrangement of the driver's cab shown in Fig. 3 ensures comfortable working conditions, and in the layout of the electrical equipment ease of operation and maintenance have been aimed at, the removal of the motor and other parts being facilitated by making the front dash

removable. The louvre ventilation is provided on the dash to ensure that the cab and motor are well ventilated at all seasons of the year. The louvres are under the control of the driver. The whole of the furniture, including handles, stair rails, brackets, &c., are covered by "Doverite," which, besides possessing good appearance, is durable and has good insulating properties. The principal technical particulars of the six-wheel double-deck vehicle shown in the illustrations are given below :—

Wheel base	16ft. 6in.
Track front axle	6ft. 5½in.
Track rear axle	6ft. 2½in.
Frame overall length	26ft. 9in.
Frame height loaded	1ft. 9in.
Width chassis overall	7ft. 5½in.
Size of tires	36in. by 8in. pneumatic
Gear ratio	9½ : 1
Centre between two rear axles	4ft.
Turning circle	59ft.
Approximate weight, chassis	4 tons 4 cwt.

A Multi-Language Interpretation System.

At the recent World Power Conference, held in Berlin, the Siemens and Halske multi-language interpretation system, which enables a speech to be delivered in several languages at the same time, proved of considerable assistance to the delegates unfamiliar with languages other than their own, and it was possible for no fewer than 430 persons

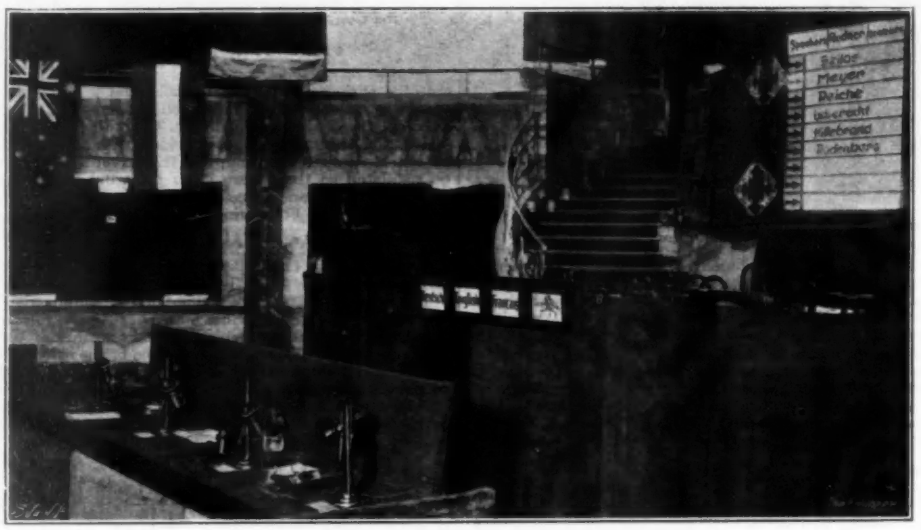


FIG. 1—MICROPHONES AND LUMINOUS INDICATOR

to take part in the discussions. In accordance with the system, the speaker addresses the meeting in the ordinary way, and at the same time interpreters translate the speech into different languages and speak in a subdued voice into microphones which are connected through amplifiers to switch boxes arranged within easy reach of the members of the conference, who can adjust the switch so as to receive on headphones any one of the languages being transmitted.

Although the number of translations that can be transmitted is unlimited, it is usually found convenient to transmit the three or four most familiar European

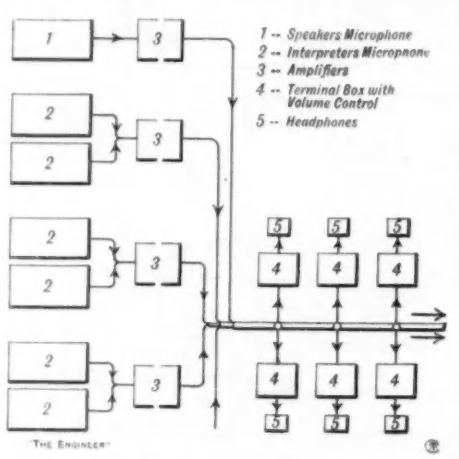


FIG. 2—GENERAL LAY-OUT

languages, the standard system being designed for six languages, including that of the lecturer. Inspection of the luminous indicator—illustrated in Fig. 1—shows the language in which the speech is being made, and by the simple operation of the change-over switch provided for each member of the conference it is possible to listen to any one of the languages being transmitted in the manner described. Another switch, mounted on the same terminal box as the change-over switch, serves for volume control. The general lay-out of the system is shown in Fig. 2, whilst the speaker's microphone is shown on the left of Fig. 3, which also shows the interpreter's microphones A and B and pick-up C. Each interpreter is provided with two microphones, so that one interpreter can relieve another without causing a break in the transmission, and for hygienic reasons each interpreter

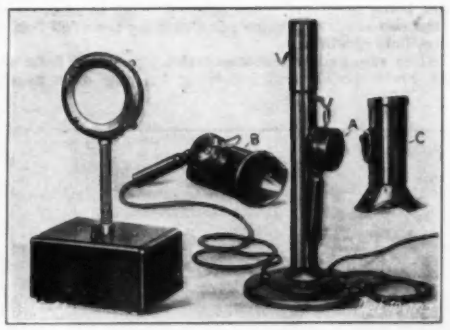


FIG. 3—MICROPHONES

is also provided with a protective inset for his own use which he can easily remove on being relieved.

The lecturer's instrument is a high quality microphone of the latest design, and when the lecturer begins to speak its circuit is closed by means of a switch and a signalling lamp lights up on the amplifier as well as on the luminous indicator. The lighting of the lamp on the amplifier—see Fig. 5—informs the attendant that the lecturer is ready to deliver his address and that the respective amplifier has been switched on, while the lighting up of the luminous indicator, which shows the name of the lecturer speaking, indicates to the members of the assembly that the speech can be listened to through the headphones. On lifting the microphones from their hook switches, the corresponding lamps light up both on the amplifier and in the conference room.

As already mentioned, the amplifier set is designed for the transmission of six different languages, and there are consequently six three-stage mains amplifiers, each fixed in a hinged frame, which can be swung out of the cabinet in the manner shown in Fig. 5, in order to facilitate changing the valves. The indicator lamps on the cabinet are indicated at A and the switches for controlling the amplifiers at B. At C there are plug holes which may be used for connecting up a pair of headphones for the purpose of controlling the volume by means of a potentiometer. As many as 500 headphones can be connected to each

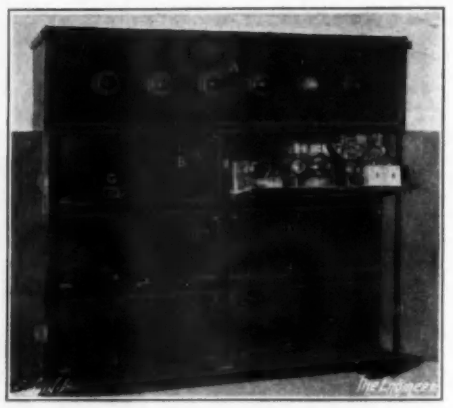


FIG. 5—AMPLIFIER CABINET

amplifier, which is fed with current directly from the lighting mains, as shown in Fig. 4, which is a diagram of connections for the complete scheme. The current for the lamp indicator is also taken from the mains through a transformer, and two dry rectifiers connected in series are used for charging the microphone battery. On concluding his address, the speaker switches off his microphone and the interpreters replace their microphones on the hook switches, the amplifiers being switched off by rotary switches. If the microphone battery shows signs of running down, the switch shown in the upper part of the diagram, Fig. 4, is thrown into the charging position.

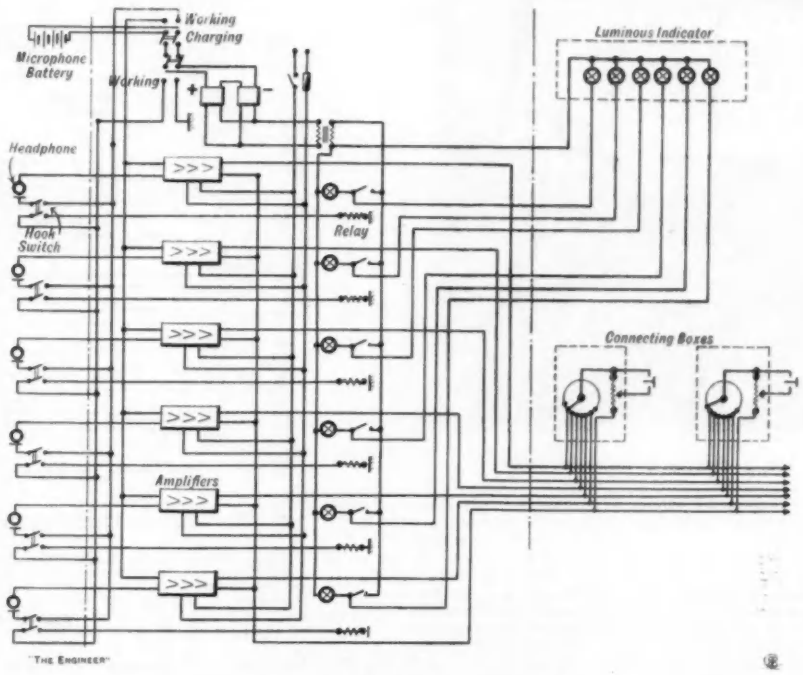


FIG. 4—DIAGRAM OF CONNECTIONS

The Performance of Two Vessels with Electric Transmission Gear.*

By W. J. BELSEY.

In this paper are described two recent examples of the application of electricity as a means of transmitting power from the prime mover to the propeller.

As an example of the turbine electric drive are given particulars and performance of the P. and O. Steam Navigation Company's "Viceroy of India";† as an example of the Diesel-electric drive are given particulars and performance of the Atlantic Refining Company's oil tanker "Brunswick."‡

With particular regard to passenger liners, the average passenger on a liner does not care, nor is he interested in the fuel consumption. The thing that he cares about, other things being equal, is his personal comfort. Therefore, the ship which is quietest and freest from vibration is the one he will travel by if he can, and in respect to freedom from vibration, the "Viceroy of India" is perfect.

* Institution of Naval Architects, April 10th. Abridged.
† See THE ENGINEER, March 1st, 8th, and 15th, 1929.
‡ See THE ENGINEER, September 7th and 14th, 1928.

The turbine-electric drive will, I believe, find its field of application in the larger-powered passenger vessels, say, from 5000 H.P. twin-screw vessels upwards, and also in those which have to meet a widely varying schedule of speeds between various ports. The Diesel-electric drive will, I feel, find its application in what might be termed "double-purpose vessels," where the auxiliary load is a large percentage of the propelling load—*e.g.*, in such vessels as fruit and meat carriers—or where the port load is large in comparison with the propelling load, as in oil tankers with large cargo pumps, and in bulk cement carriers. The Diesel-electric drive is particularly suited to tow boats, where the load and speed requirements are unsuited to the characteristics of a Diesel engine, and where manœuvring properties are of very great importance.

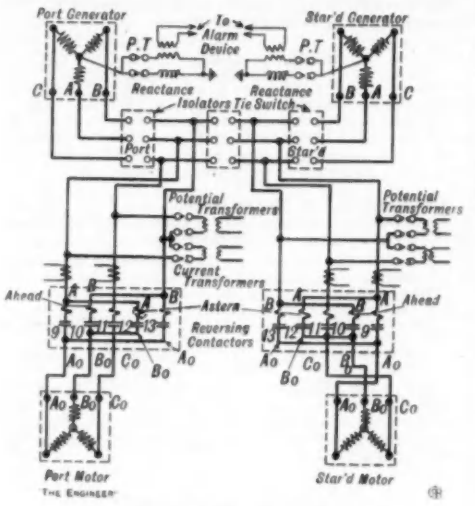


FIG. 1—SIMPLIFIED MAIN CIRCUITS

Bridge control in these cases is a great asset. As the development of a reliable high-speed Diesel engine proceeds, so will the Diesel-electric drive become more attactive.

"VICEROY OF INDIA."

The "Viceroy of India," which was built by Messrs. Alexander Stephen and Sons, Linthouse, Glasgow, was laid down in May, 1927, and completed in February, 1929. The following are the principal particulars of the vessel :—

Hull.

Length overall	612ft.
Breadth	78ft.
Gross tonnage	19,700 tons
Mean displacement	25,000 tons

Propelling Machinery.

Number of main propelling motors	Two
Designed output, each	8500 S.H.P.
Speed at 8500 H.P.	109 r.p.m.
Number of turbo-alternators	Two
Designed output	9,000 kW

Auxiliary Generators.

Auxiliary turbo-generators	Four 500 kW
Auxiliary oil engine generators	Two 165 kW for port use
Emergency oil engine generators	One 50 kW

Boiler Equipment.

Make of boilers	Yarrow water-tube
Number of water-tube boilers	Six
Designed working pressure	375 lb. gauge
Total temperature	700 deg. Fah.
Scotch auxiliary boiler	Two

The vessel was designed for the mail service between London and Bombay, and is required to steam at widely different speeds and powers between the various ports of call :—London to Gibraltar, 15·24 knots; Gibraltar to Marseilles, 14·3; Marseilles to Malta, 18·1; Malta to Port Said, 18·25; Suez to Aden, 17·82; Aden to Bombay, 15·96 knots.

In addition to this variable speed service, in order to make up time due to delays in the overland mail service or delays due to fog or bad weather, the vessel has to have plenty of power in hand. In order to meet these conditions, each turbo-alternator is designed to be of such capacity as to give a total of 11,600 S.H.P. to the two propeller shafts, say, 5800 S.H.P. each. This gives a comfortable sea speed of 16½ knots. Therefore, with any speed below 16½ knots, only one turbine is required, the other turbine with all its auxiliaries being shut down completely. The Yarrow boilers have also an ample margin in hand for higher powers.

Controls.—Fig. 1 shows the main electrical connections with the ahead and astern contactors and the switches, which enable two motors to be driven by one turbo-alternator. These switches are so interlocked that if both port and starboard switches are closed, the tie switch must be open; or if the tie switch is closed, then only one of the turbo-alternator switches can be closed. The time required to change the electrical connections without any hurry from the port generator driving the two propellers to the starboard generator driving the two propellers or two turbines driving two motors is 1 minute 32 seconds.

The contactors are operated electrically by means of a solenoid on each contactor, but are locked mechanically in position by means of cams on the cam shafts, and current is cut off the solenoids; also the cam shaft operation provides a stand-by in case a solenoid breaks down. The current and potential transformers shown in Fig. 1 are provided for operating the measuring instruments and for protection.

For each propeller, three controlling levers are provided for operating the contactors and regulating the speed setting of the turbine governor :—(*a*) A reversing or direction lever; (*b*) field and speed-controlling lever; (*c*) a dead-slow speed lever.

These levers are all mechanically interlocked to ensure correct operation. Lever (*b*) operates the field contactors, and also the speed settings of the turbine governor, and before any field contactors can be operated, the turbine governor must be in the slowest speed setting—about one-fifth speed. Also this lever must be in the "off" position, and therefore all field circuits open, and, consequently, the alternator dead before the reversing levers can be operated, so that in no circumstances can there be any live switching of the main power. The dead-slow lever is provided for occasions when it is required to run at speeds varying from 5 to 20 r.p.m.

Insulation.—The tests to which the insulation of the machinery of the "Viceroy of India" was submitted may be of interest.

Six finished coils were selected at random, and one of these was subjected to a test extending over twelve months, during which time the coil was immersed in a tank of sea water from one day to two months, and at intervals the insulation resistance was measured by means of a 500-volt megger and was found to be infinity in all cases. This coil was heated up to a high temperature, and then immersed in salt water for two days, after which the insulation resistance was measured and found to be infinity. After standing several months encrusted with brine in a normal atmosphere, high-voltage tests were carried out to ascertain the breakdown voltage. The normal voltage to earth is 1700 volts, and the instantaneous breakdown voltage was 30,000 and a voltage of 22,500 was applied for one minute without breakdown. The remaining five coils were subjected to a test of being submerged in sea water for a week, then hanging in a normal atmosphere for another week, and then reimmersed; all the coils remained at an insulation resistance of infinity. If the electrical propulsion machinery of the "Viceroy of India" were completely flooded and remained under water for some months, and if the windings were wiped down and dried out by passing a heavy current at a low voltage, the insulation would not have deteriorated, but would be as good as ever.

Protection of Electrical Machinery.—As Fig. 1 shows, the neutral point of the system is earthed through a reactance, the function of which is to limit the amount of current flowing to earth should a fault occur. Before any current can flow to earth, it is necessary for another point of the system to be earthed, and if a fault does occur on any part of the system, then current will flow through the reactance to earth, and will operate an alarm device. So long as there is only one earth on the system, the machinery can be worked quite safely; so that all the operator has to do if a fault does occur is to open the permanent or intentional earth and then at some convenient time look for the fault and clear it.

With regard to overloading the machinery, the electrical machines are largely self-protecting. Say the propeller strikes a bank, fouls a line, or is overloaded by some means, the motor and the alternator break out of step and a wattless current flows through the system, which does no harm provided it is not left on for an undue length of time, say, 20 minutes. As the generators are larger in capacity than the motors, it was necessary when each generator is driving one motor to protect the latter from possible overload. This was taken care of by automatically closing a turbine control valve when the speed lever came into the position corresponding to 96 r.p.m. This makes it impossible for the turbine to pass any more steam than

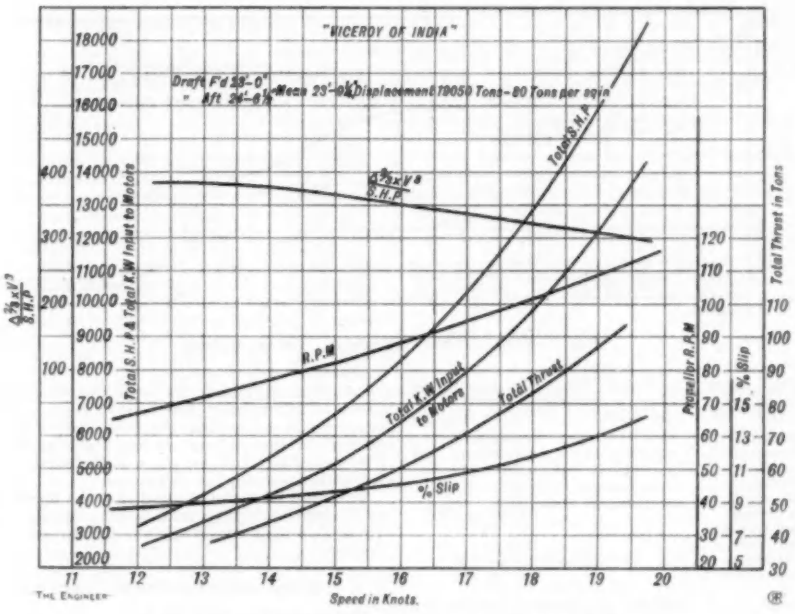


FIG. 4—"VICEROY OF INDIA" TRIAL RESULTS

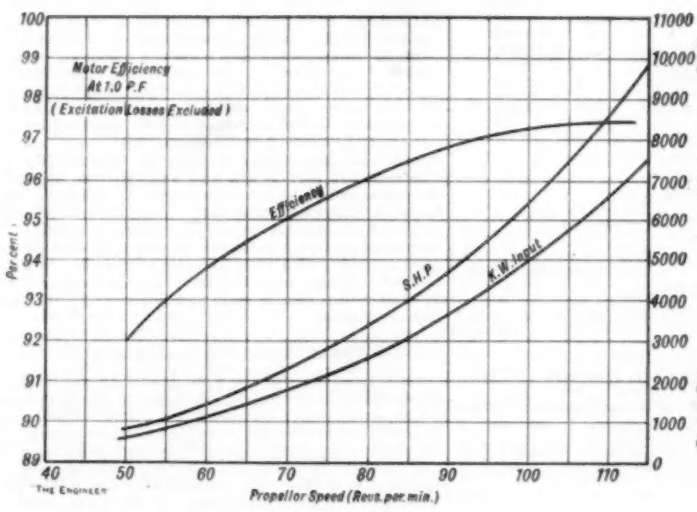


FIG. 2—INPUT S.H.P. AND EFFICIENCY CURVES

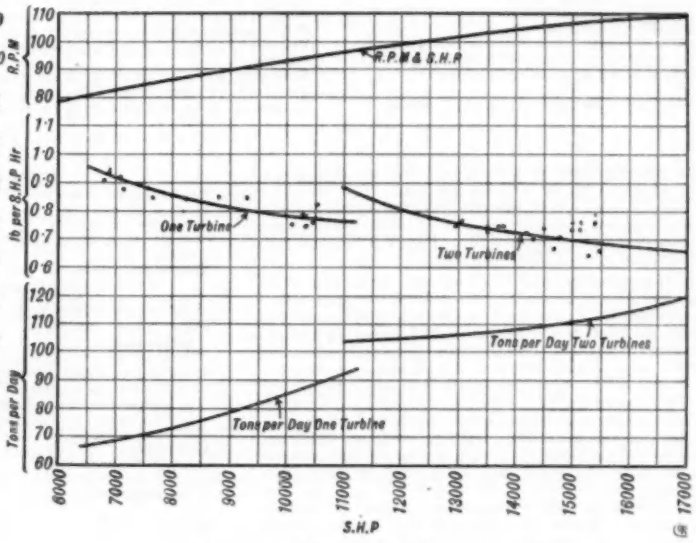


FIG. 3—CURVES OF FUEL CONSUMPTION

that which gives 8500 horse-power at the motor shaft.

Efficiency of Transmission.—The actual efficiencies of the main propelling machinery as tested are given below. The motors were tested at full load by the Hopkins method. In addition to this, the efficiency was ascertained by the segregation of losses, and both agreed :—

Load, S.H.P.	17,000	11,600
Propeller, r.p.m.	109	96
Efficiency—		
Alternator, per cent.	96·65	97·1
Motor, per cent.	97·49	97·1
Excitation, total, per cent.	1·0	1·2
Overall efficiency, per cent.	93·55	94·00

On Fig. 2 the kilowatt input to the motor at various speeds and powers is given, and as the efficiency of the motor is within one-tenth of 1 per cent., the horse-power to the propeller shaft can be accurately determined. Fig. 2 also gives the actual efficiency of the motor at various loads and speeds.

Trials.—The "Viceroy of India" was put through an exhaustive series of trials on the Clyde, and the results of these trials are shown in Fig. 4. The following are the particulars of the vessel at the time of the trials :—

Displacement	19,050 tons
Mean draught	23ft. 9¼in.
Block coefficient	0·63
Area coefficient	0·953
Prismatic coefficient	0·663
Wetted surface	55,000 sq. feet
Propeller diameter	18ft. 9in.
Propeller pitch	20ft. 5in.
Propeller blades	Three
Propeller surface	101 sq. feet

For the purpose of retaining a permanent record of the power absorbed when manœuvring, an instrument panel was fitted up and the instruments connected to the various circuits, and during the manœuvring periods a cinema record was taken, and from them design data have been checked.

Referring to Fig. 4 it should be noted that speeds up to 17·1 knots were obtained with one alternator driving two motors ; above that speed two turbo-alternators were running.

The power was measured on each side of the ship by two Elliott Bros.' standard wattmeters, which were calibrated and were correct within one-tenth of 1 per cent.

Manœuvring.—By means of the cinema record taken of the instrument panel mentioned above, it was possible to ascertain accurately the time required for carrying out orders from the bridge, and a number of these operations are tabulated below :—

Manœuvring operations using one alternator ("Viceroy of India").

Port propeller.	Starboard propeller.	Time occupied.
Starting up, 0–44 r.p.m. ahead	Starting up, 0–44 r.p.m. ahead	4 seconds
Starting up, 0–58 r.p.m. astern	Stopped	7 seconds
Running, 48 r.p.m. ahead	Stopping from 48 r.p.m. astern	7 seconds
Stopped	Reversing, 48 r.p.m. ahead to 44 r.p.m. astern	10 seconds
Reversing, 47 r.p.m. astern to 47 r.p.m. ahead	Stopped	12 seconds
Decreasing, 63 r.p.m. to 45 r.p.m. ahead	Reversing, 63 r.p.m. astern to 45 r.p.m. ahead	16 seconds
Stopped	Reversing, 49 r.p.m. ahead to 44 r.p.m. astern	10 seconds
Reversing, 23 r.p.m. ahead to 33 r.p.m. astern	Reversing, 23 r.p.m. ahead to 33 r.p.m. astern	7 seconds

A full-speed reversal was carried out with the ship steaming at 18½ knots, 19,000 tons displacement. The propellers were turning astern in 30 seconds from the signal, and the ship was stopped in 2 minutes 10 seconds by observation on shore, say, 3·7 ships' lengths. Fig. 5 shows the full-speed reversal plotted from the cinema record.

Fuel Consumption.—By the courtesy of the P. and O. Steam Navigation Company, through its superintendent engineer, Mr. R. T. Clarke, I am able to give in tabular form an abstract of the log of the "Viceroy of India" on her maiden voyage. This abstract* gives full particulars of speed, slip, displacement, and fuel consumption, &c. In working out the fuel rate per S.H.P., no attempt has been made to correct for vacuum, steam pressure, or superheat. The column giving tons per day is for all purposes, including propelling, heating, lighting, cooking, which are all carried out electrically. Also the tons per day includes steam used for the galley and for the calorifiers, evaporators, &c.

Curves showing tons per day and pounds of fuel per S.H.P. for all purposes are given in Fig. 3. The vessel has never yet had occasion to develop her full power of 17,000 S.H.P. at sea ; but from the slope of the curve and the eight-hour full-power consumption run taken on the Clyde it is clearly shown that the fuel consumption per S.H.P.-hour for all purposes, when under full load at sea, with the full complement of passengers, is under 0·65 lb. per S.H.P.-hour.

Taking into account the fact that at low powers the auxiliary load is 11½ per cent. of the propelling load and at higher powers it is only 7·75 per cent. of the propelling load, it will be seen that the fuel consumption over a wide range of load from 7000 to 15,000 S.H.P. is extremely good, and I do not think any other steamship can show such good figures at all powers. It also demonstrates that whilst having a low fuel consumption at low powers, this feature has not been obtained by sacrificing economy at the higher powers. The high efficiency of the Yarrow boiler installation, of course, has a considerable bearing on this good result, and such equipment is finding increasing favour in the mercantile marine.

It should be noted that the sea water temperature through which the ship steams will not permit of a higher average vacuum than 28·15in. If this vessel were sailing on the North Atlantic, where 29in. vacuum is obtainable, the results would be improved by about 5 per cent. Also it should be noted that all the auxiliary power is generated by steam ; if this power were generated by oil engines, then the overall consumptions would be reduced, but, due to the extra cost of Diesel engine fuel oil and the extra cost of lubricating oil for the Diesel engines and the additional capital outlay, it is doubtful whether there would be any financial gain to the owners by generating auxiliary power by oil engines. Also in the summary of the voyage it should be noted that the lubricating oil consumption during the first voyage averaged 6·1 gallons per day ; the lubricating oil consumption on the last voyage averaged 2·2 gallons per day for all purposes.

It should be borne in mind that the figures given refer to the maiden voyage, and, as is to be expected, her last voyage shows a considerable improvement over the first voyage.

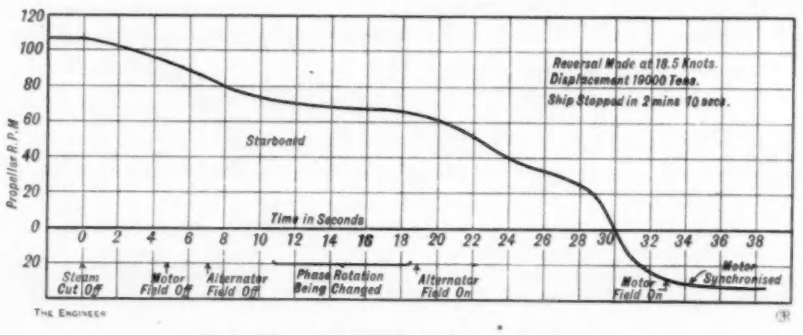


FIG. 5—FULL SPEED REVERSAL TRIAL CURVE

DIESEL-ELECTRIC VESSEL "BRUNSWICK."

This tanker was built by Scott's Engineering and Shipbuilding Company for the Atlantic Refining Company, and is fitted with Diesel-electric drive.

By the courtesy of the Atlantic Refining Company, through its engineer, Mr. Lester M. Goldsmith, I give below the trials and voyage performance of the "Brunswick" :—

Particulars of Hull.

Length overall	=471ft.
Length, L.W.L.	=469ft.
Breadth	=63ft.
Draught, normal	=26ft. 6in.
Draught, maximum	=28ft.
Depth, normal	=37ft.
Displacement	=17,275 tons at 26ft. 6in.
Displacement	=18,775 tons at 28ft.
Block coefficient	=0·785 at 26ft. 6in. draught

Engines.

Four Ingersoll-Rand Carels, six-cylinder	
Normal rating	=750 B.H.P.
Revs. per minute	=225 revolutions
Normal mean effective pressure	=63 lb.
Fuel consumption	=0·41 lb. of oil per B.H.P.

Electrical Equipment.

Four 600-kW, 2,400-amps., 250-volts, 225 r.p.m. generators	
Four 75-kW, 300-amps., 250-volts, 225 r.p.m. auxiliary generators	
Efficiency main generators	=94·8 per cent.
Efficiency auxiliary generators	=89·7 per cent.
Excitation main generators	=4·14-kW each
One double-unit motor, 2,800 S.H.P., 2,400 amps., 95 r.p.m., 1,000 volts	
Efficiency of motor	=95 per cent.
Excitation	=100 amps. = 25 kW
Overall efficiency	=90 per cent., excitation excluded
Total excitation	=16·5 + 25 = 41·5 = 2 per cent.
Overall efficiency, including excitation	=88 per cent.

Weights.

	Tons.
Four main and auxiliary generators	= 75·6
One main motor	= 75·3
Control gear	= 7·2
Total	158·1
Four engines	=320
Total	=478·1

Trials.—Trials took place on the Skelmorlie mile at full displacement. Two double runs, 17,275 tons displacement, 26ft. 6in. draught, gave the following results :—

	Knots.	Propeller, r.p.m.	Kilowatts to motor.	S.H.P.
Down	11·39	97·0	2050	2610
Up	11·597	98·1	2030	2580
Down	11·548	97·1	2110	2680
Up	11·42	97·8	2010	2565
Mean	11·479	97·5	2055	2609

$$\frac{\text{Displacement}^{\frac{2}{3}} \times V^3}{\text{S.H.P.}} = 386.$$

Auxiliary load = 89·5 kW, including excitation.

Auxiliary load = 89·5 − 41·5 = 48 kW, excluding excitation.

Two double runs, 18,775 tons displacement, 28ft. draught, gave the following results :—

	Knots.	Propeller, r.p.m.	Kilowatts to motor.	S.H.P.
Down	11·447	96·4	2000	2550
Up	11·009	96·2	1930	2460
Down	11·339	95·4	1910	2435
Up	10·909	95·8	1930	2460

$$\frac{\text{Displacement}^{\frac{2}{3}} \times V^3}{\text{S.H.P.}} = 402.$$

The Auxiliary load was as before.

The following is the result of voyage No. 7 of the "Brunswick" from Melbourne to San Pedro :—

Time	26 days 3 hours 54 minutes
Distance	7023 miles
Speed	11·2 knots
Total fuel consumed	345 tons
Tons per day	13·2 tons for all purposes
Average S.H.P.	2680 S.H.P.
Fuel consumption	0·46 lb. per S.H.P.-hour for all purposes

Since being placed in commission, this vessel has motored 98,350 sea miles, and has been at sea 409 days out of a total of 446 days, which I think you will agree is a creditable performance, and gives evidence of the reliability of this type of drive.

* Not reproduced, ED., THE E.

South African Engineering Notes.

An Industrial Centre.

AT the recent meeting of the Midland Chamber of Industries (Cape Province), the President pointed out that Port Elizabeth, as a result of its industrial activity, was destined in the near future to be one of the leading, if not the foremost, industrial cities in South Africa, favoured, as it is, geographically as a distributing centre and having a cheap power supply and many excellent industrial sites. The city now possesses no less than 35 separate industrial enterprises, included in which are cement, milling, joinery and sawmills, shirt and clothing manufactures, furniture, fruit canning and soap factories, motor car assembling works, boot and shoe manufacturing works and tanneries, &c. In these various establishments are employed over 10,000 workers, who have quite 20,000 dependents. The wages paid to these workers are in excess of £1,300,000 per annum, and the value of the materials used exceeds £4,000,000 per annum.

Mining Expenditure.

The gross expenditure of the several mining industries of the Union upon machinery and stores reached the highest point in the history of the country in 1929. The expenditure under these heads amounted to the record figure of £17,960,868, an increase of £107,937 over 1928. But the point of most real interest to South Africa is the continued increase in the purchase of local products. Whereas in 1927 out of a gross expenditure of £17,569,544, 62 per cent.—£10,860,960—was spent on South African products. In 1929, of the £17,960,868, no less than £11,506,623, or 64 per cent., was spent on local productions, representing an increase of nearly three-quarters of a million pounds. Among large lines for which the Union has almost ceased to go abroad are the following :—Explosives, £2,117,585 obtained in South Africa, £495,790 imported ; electric power, light and compressed air, £2,288,630, all obtained in South Africa ; food and fodder, South Africa £1,243,697, from overseas nil ; coal and coke, South Africa £1,022,794, overseas nil ; timber, £1,005,271, overseas £392,791. South Africa supplies the following :—Gelatine, gelignite and dynamite, £1,896,022 ; mining poles and lagging, £684,544 ; lime, £181,745 ; cement, £178,675 ; concrete pipes and block, £149,828. The industry has, however, entirely to import petrol, £571,246 ; cyanide, £339,799 ; structural steel, £306,939 ; rock drills, £86,569 ; safety fuses, £115,260 ; galvanised iron, £28,962. In a short time the cyanide mentioned above will also be produced here.

The Port of Durban and Manganese Ore.

Activities at the port of Durban are likely to be considerably increased by the loading plant at Congella for the handling of manganese ore, which is being mined in the Postmasburg district of the Cape Province. Work on the loading plant has already been started. Offices and storage sheds will also be erected at Congella. It is expected that three ships a week will call at the port to load the ore. It is stated that in about two years' time the company hopes to open manganese works at Colenso, Natal, where the ore will be treated and converted into ferro-manganese. The loading plant is of the most modern type, and will be capable of handling 500 raw tons per hour. The storage capacity of the plant at Congella will be 50,000 tons.

New Mining Device.

Rubber collars to replace the forged collars on the shanks of drill steel are one of the latest patented mining devices designed to bring about greater efficiency. Continual experiment and practical test over a considerable period at several mines, have, it is understood, gone to

show that this rubber collar is a decided improvement upon the forged collar, and is likely to become widely adopted wherever jack hammers are operated. The new rubber collar is claimed to prevent the serious breakages of steel resulting from its structure being disturbed by the forging process necessary for the making of steel collars. When using the rubber collar the shank end of the drill steel need only to be heated sufficiently for tempering. The size of the jack hammer drill steel most commonly in use on the Rand is ⅞in.—hexagon steel is used normally with this patent—and to fit the shank the rubber collar is cut from special quality ⅞in. air hose, each collar being 1⅞in. in length. This length of hollow tube or rubber collar is forced over the shank end of the drill steel into the position of the old-fashioned forged collar. Behind the steel-bound collar another and renewable ⅞in. rubber collar is on occasion used as a washer to take the concussion. After wear and tear the cushion collar can be renewed easily.

Tenders for Steel Works Plant.

Definite information with regard to the tenders for the South African Iron and Steel Industrial Corporation's new works was supplied by the Chairman of the Corporation before leaving for Europe recently. Dr. H. J. van der Byl stated that twelve tenders had been received for the plant and equipment for the blast-furnace, steel melting and steel rolling sections of the new works at Pretoria. These tenders were from leading British and German firms, no offer having been received from America. He thought the contract would be placed in the course of the next two or three months, the final decisions to be taken in London. Dr. van der Byl added that tenders would be called shortly for the coking plant. The contract for the preparation of the site for the works has been let to Hubert Davies and Co., Ltd. The contract covers an outlay of some £60,000 on excavations, terracing, embankment, railway siding, roadways, and the like. The contractors for the preparatory work on the site are also the South African agents for Ruston-Hornsby power shovels and excavators, and it is certain that equipment of this kind will be freely used on the job. The site is about four miles from Church-square, Pretoria, on an undulating slope with a halfmoon of hills running along the southern and western boundaries, and is delimitated to the north by the railway line from Pretoria to Roberts Heights, the military cantonments. The maximum gradient of any railway line serving the various departments will not exceed 1 in 75. The existing railway to Roberts Heights is partly within the works area and is built to a ruling gradient much heavier than is suitable for the handling of heavy trains of raw material into the works. This line is therefore being deviated to the north, giving extra distance, and thus an easier gradient and, incidentally, giving space for the marshalling yards for inward and outward works traffic, which is estimated to attain to a million tons per annum when the works get into their initial stride. It is expected, however, that this tonnage will, in the course of a few years, be considerably exceeded. Part of the iron ore for feeding to the blast-furnaces is to be produced almost on the site of the works. Indeed, the Roberts Heights railway is ballasted with the same ore as will be fed to the furnaces. Dolomite will also be quarried at hand. Coal for coke making will be brought from the Witbank field, which is only 80 miles away, as it has been proved possible to turn out good metallurgical coke from the Witbank Main seam. Another part of the ore will be brought by rail from the north-west corner of the Pretoria district over a continuation, to be built, of the Brits-Beestekraal branch line. This ore is a very pure hematite, averaging, it is claimed, 68 per cent. metallic iron and about 1½ per cent. silica. It is literally too pure to function satisfactorily as regards fluxing in a blast-furnace, but a mixture of it with the quartzitic hematite and clay-band ores available on the spot should prove satisfactory.

Johannesburg's New Plant.

During the past few months the capacity of the new Jeppe-street generating station of the Johannesburg City Council has been increased considerably by the addition of new plant. Two new 10,000-kW Fraser and Chalmers-B.G.E. turbo-alternators have been put into commission, making a total of 30,000 kW available in this portion of the plant. Four new Babcock and Wilcox boilers, each of a capacity of 60,000 lb. of steam per hour at 350 lb. per square inch working pressure, have also been installed, bringing up the complement of boilers in the Jeppe-street boiler-house to six, all of similar type. The cooling tower equipment at this station is also being extended by the addition of a bank of four "Premier" natural draught cooling towers of a total capacity of 1,400,000 gallons per hour; this contract is rapidly nearing completion, two of the cooling towers being already in commission. The coal-handling plant for the new station is also well under way towards completion. The tunnel connecting the boiler-house with the coal storage yard and railway sidings is being completed, and the work of installation of the necessary conveyors, &c., is proceeding. A start has also been made with the ash-handling plant, which is of the sluicing type. The Jeppe-street generating station is therefore rapidly approaching a state when it will be able to take over the major portion of the generation of electricity for Johannesburg, with the consequent release from continuous service of the old and inefficient plant at the President-street station.

Automatic Telephones.

The first section of the new automatic telephone system to be installed in Johannesburg will be in operation in about fifteen months' time. This will comprise the area to be served by the new City Exchange to be built at the corner of Fox and Maclaren streets. Plans have been drawn up and adopted for converting, not only the Johannesburg area itself, but also the whole of the Reef to automatic working, and in connection with this work and the conversion of the Cape Town area to automatic, contracts have been entered into with Siemens Bros., Ltd., of Woolwich, and the Automatic Telephone Manufacturing Company, Ltd., for the necessary equipment to be supplied over a period of five years. The outlay involved is approximately £750,000. Questions were asked in the Union Parliament about this contract, and the Minister of Posts and Telegraphs explained that the step-by-step system had been decided upon. Tenders were not publicly invited. The position was that the four chief manufacturers were the proprietors of the patent, and they shared the patent among them—the fifth company was not allowed to supply South Africa. Two of these firms were in England, one in Chicago, and one in Berlin. The firms were approached, with the result that the Chicago company quoted far too high a price and the German firm declined to quote at all, but offered merely to come out to South Africa to advise what should be done. The only two satisfactory offers, in consequence, came from the two British firms, with which the Government had entered into contracts at prices which compared very favourably indeed with the prices at which they had supplied the British Government and which afforded opportunity of certain discount on account of the Union requirements fitting in with the plant supplied to the British Government.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

August Holidays.

INDUSTRIALLY, the week has been almost a complete blank in the Midlands and Staffordshire, works generally having lain idle during the whole period. It is customary for many of them to resume operations at mid-week, but order books are so thin this year that managements did not consider it advisable to start the plant for a couple of days. In very few instances is there a satisfactory carry-over of business, and when works resume it is improbable that it will be on full time. During the holiday period, repairs have been carried out at some of the establishments, and plant put into trim in preparation for whatever may come along. The weekly meeting of the iron trade in Birmingham to-day—Thursday—was sparsely attended, and no great bulk of business was transacted. Here and there orders were placed for material required next week, but the tonnages were small. There was insufficient business to test prices, and quotations were as they were a week ago.

Raw Iron.

The action of the Central Pig Iron Producers' Association in granting a further price concession of half a crown per ton is commended, and it is stated that business is likely to be considerably brighter after the holidays as a result. It is noted that the furnacemen claim to have made the reduction in order, if possible, to stimulate trade. After the Association meeting last week the furnacemen issued a statement which explained that they had considered the representations made to them by a delegation of the Birmingham Chamber of Commerce, and decided to make the further reduction in order, if possible, to stimulate trade. Whether it will have the desired effect remains to be seen. This week, of course, there has been no chance to gauge the effect, business having been negligible, owing to the consuming works being closed for the holidays. Stocks in users' hands are notably small at date, owing to the policy recently adopted of waiting until stocks are practically exhausted before ordering further supplies, and then taking only just sufficient to cover immediate needs. Smelters trust that some big scale business will now develop and that foundrymen will endeavour to forecast requirements and contract accordingly. While continental competition has not assumed serious proportions in this area, the resentment amongst ironfounders against the Central Pig Iron Producers' Association has been such that a fair amount of business has actually been offered to merchants who could bring continental pig iron into Birmingham at a competitive price. Despite the slump in values, however, that has not been possible, since furnacemen reduced prices by half a crown. Now that native material is still cheaper, foreign iron is right out of the running as far as Birmingham is concerned, and it is probable that we shall hear very little of it in the immediate future. The range of pig iron prices for this area is:—Northamptonshire forge, £3 5s.; No. 1 foundry, £3 13s.; No. 2, £3 12s.; No. 3, £3 10s.; No. 4, £3 9s.; Derbyshire forge, £3 8s. 6d.; No. 1 foundry, £3 16s. 6d.; No. 2, £3 15s. 6d.; No. 3, £3 13s. 6d.; No. 4, £3 12s. 6d.—delivered at stations in the Black Country.

Steel.

The market for finished steel has not much life. Midland constructional engineers are getting a few orders—sufficient to keep the men at work—but prices are stated to be unremunerative, owing to severe competition. Rolling stock establishments furnish some useful orders, and automobile engineers provide others. The demand from the latter source is dwindling, however. Boiler-makers and others take moderate supplies of plates, but the mills could turn out much more material were it required. Values are upheld at the Association figures:—Angles, £8 7s. 6d.; tees, £9 7s. 6d.; joists, £8 10s.; ship, bridge and tank plates, ⅜in. and over, £8 17s. 6d., subject to rebate; boiler plates, £9 12s. 6d. upwards. In the half-products branch foreign influences are seriously affecting the market. Continental steel prices have fallen to a low level since the collapse of the cartel, and producers at home are working under a great disadvantage. Sheet bars of foreign make are down to about £5 5s. to £5 6s., compared with the district price of £5 15s. up; foreign billets cost about £5 5s. to £5 6s., according to size, compared with the home price of £5 17s. 6d. upwards. It is stated that a good order for native billets would probably be accepted at below the figure mentioned above. Steel-masters hereabouts report that even where the order books are fairly healthy, requests are coming in for suspension of delivery. This applies also in the case of steel scrap, in which market prices are very weak.

Staffordshire Bar Iron.

In the Staffordshire iron trade there is very little new business being done. Some of the marked bar mills are able to make a fair output, but the flow of orders fell off just prior to the holidays. Makers of best bar iron are in a position to make a good start on Monday week, but the outlook in other branches of finished iron is poor. Prices stand as they were in regard to all types of wrought iron, and there is no sign so far of any reduction being made as a result of the lower cost of pig iron. Marked bars are quoted £12 10s.; Crown bars, £10 upwards; nut and bolt and fencing bars, £9 upwards; wrought iron tube strip, £11 2s. 6d.; No. 3 Belgian iron costs £5 13s. delivered, but there is not much demand for this material. Much of this iron is of a steely character, and many local works which formerly made use of it have changed over in recent years to the use of steel. The Black Country tube trade is not so brisk as it was, and the call for strip has consequently not been maintained.

Galvanised Sheets.

Prices of galvanised sheets are stationary at £11 17s. 6d. for 24 gauge corrugateds. The industry continues to share in the seasonal quietude. Some Midland mills, however, are fairly well booked, and the holiday stoppage in these cases will not be unduly prolonged. The overseas markets remain very quiet, but an early expansion of demand from one quarter at least is anticipated. Home consumption is maintained at about recent levels.

Imported Bolts, Nuts and Screws.

Manufacturers of nuts and bolts in the Darlaston district are pleased that an Order in Council under the Merchandise Marks Act has been made requiring imported bolts, nuts, rivets, set screws, coach screws, and boiler-makers' and engineers' studs of iron or steel to bear an indication of origin at the time of sale or exposure for sale in the United Kingdom. The Order, it is understood, will come into force on October 28th. Increased work for local producers of these articles is expected as a result.

Cannock Chase Coal.

There was a loss of 2s. 2·22d. on every ton of coal raised in the Cannock Chase and Pelsall coalfield during the month of June. Miners' wages for August will continue at 42 per cent. on the 1911 basis, which gives stallmen a minimum wage of 9s. 4d. per day. August rates are based on the proceeds of the industry for April, May, and June, when the capacity to pay was only 25·2 per cent., the balance having to be provided by the coal-owners. The owners' accumulated deficit now totals £1,262,207.

Automobile Engineering.

The automobile industry in Birmingham, Coventry, and Wolverhampton is slow, and the reluctance of makers to place contracts for the new season's programme is affecting the sheet metal, stamping, and pressed steel firms. A few are fairly well situated, but the majority of the smaller concerns are not turning out much work.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Big Drainage Scheme and Direct Labour.

MANCHESTER City Council has adopted the proposals of the Rivers Committee regarding the construction of the main drainage system on the Wythenshawe estate, which is to be developed for the purpose of a large housing scheme. The estimated cost of the drainage work is £478,000, and the City Council has sanctioned the expenditure of £120,000 during the current year. Some objection was raised to the City Engineer's proposal to employ direct labour on the greater part of the scheme, but it was urged that this would be justified by the estimated saving of three months and that was the view eventually taken by the City Council.

Financing Rural Water Supply.

The recommendations of the Public Health and Housing Committee of the Lancashire County Council to finance a loan of £50,000 in each of the next ten years for the purpose of assisting the smaller local authorities to provide water supplies and sanitary services which they cannot afford by themselves, have been adopted. The chairman of the Committee explained that the underlying idea of the scheme was to spread the cost of local work over a larger area and to stimulate local authorities to carry out works which, under restricted financial conditions, they otherwise could not afford. In certain parts of the county, a medical member of the County Council stated, people in country districts were drinking canal water and could afford no other source of supply.

Constructional Engineers' Results.

Although below the level of the previous financial year, the net profits of Edward Wood and Co., Ltd., constructional engineers, of the Ocean Ironworks, Manchester, for the year ended May 31st last, make a satisfactory showing considering the general difficulties met with during the past twelve months. The net profits for the period under review amounted to £20,187, against £23,311 in the previous year, and £20,139 in 1927–28. A final dividend on the ordinary shares of 4½ per cent., making a total distribution of 7 per cent., brings the return to shareholders to last year's level. In the twelve months ended May, 1928, the ordinary dividend was 6 per cent., and in the year 1926–27, 4 per cent.

Nottingham Coaches for the Argentine.

Last week-end twenty-two railway coaches made in Nottingham for underground service in Buenos Aires left Ellesmere Port on the Manchester Ship Canal, forming the bulk of the cargo of the Norwegian vessel

"Belpamela." After being railed from Nottingham to Ellesmere Port, the coaches were transferred to the Ship Canal Company's wharf, where they were sprung and mounted on bogies ready for placing on the track in the Argentine. Another consignment is expected to be shipped in September.

Tramcars to Omnibuses.

Wigan Town Council has decided to scrap its tramway system and to change over to motor omnibuses. Application is to be made to the Ministry of Transport for sanction to borrow £62,700 for the purchase of thirty-eight additional vehicles.

Steel and Coal Mergers.

Registration of the Lancashire Steel Corporation and the Wigan Coal Corporation, which have been brought into existence to take over the businesses of a number of well-known Lancashire concerns in the iron, steel and coal industries, has now been completed. The former has a total nominal capital of £5,750,000, and the latter of £1,746,555, the boards of directors of the two corporations being largely identical.

Non-ferrous Metals.

Tin has continued to be the centre of attraction in the market for non-ferrous metals during the past week, and although values are not very much higher on balance for the week the slight change that has occurred has been upward. Market opinion in the tin section has been influenced largely by the stronger statistical position, based on prospects of reduced production, the July returns also pointing to increased deliveries compared with the previous month. At the moment, however, sentiment in connection with copper is distinctly bearish, and neither in standard nor refined descriptions has buying interest during the past week been at all satisfactory. Prospects of a stronger market in this section are less pronounced than they were quite recently and a slight loss compared with a week ago has to be recorded. The demand for lead has been rather quieter, but supplies of the metal are well held and values have shown relatively little change. Spelter has lost some ground after the firmer feeling previously recorded, and supplies appear still to be largely in excess of the demand.

Iron and Steel.

The iron and steel markets locally have been quieter than usual in consequence of Bank Holiday influences, but interest in the foundry iron section has been maintained as a result of the fresh reduction in Midland brands, Staffordshire and Derbyshire descriptions being half-a-crown lower than a week ago at 72s. per ton delivered to consumers in the Manchester price zone, with forge iron similarly reduced to 67s. It will be interesting to observe whether, when the holiday season is at an end, the cheaper raw material will have any stimulating effect on foundry trade conditions. Other varieties of iron are about unchanged at from 93s. to 94s. per ton for Scottish No. 3 and about 87s. for West Coast brands of hematite, both delivered equal to Manchester. The demand for finished iron is of a hand-to-mouth character, but prices keep up at £10 5s. per ton for Lancashire Crown bars and about £8 15s. for No. 2 quality. Steel movements this week have been rather restricted in respect both of new bookings and of deliveries against old commitments, particularly among constructional engineering firms in Lancashire. Home and continental prices, although the latter are still weak and uncertain, show very little actual change compared with a week ago.

BARROW-IN-FURNESS.

Hematite.

Quite apart from holiday slackness, the weakness of the pig iron market is more marked than ever. The bringing down of the price of ordinary mixed numbers is evidence of the lack of life in the market and of an attempt to clear some of the stocks which are accumulating at most of the works. Millom is holding its own the best, and this may be due to two reasons. The company owns ore mines and has cut production costs to the very lowest. There is no talk of restriction there, at any rate. Foreign business is not as good as it was, and this is a rather significant feature of the present quietness in business. One thing is certain, the present production on the whole largely exceeds the demand, and, therefore, reduction of output is the only way to meet the situation. The furnace at Backbarrow, which at one time was the only one engaged in this country in producing high-grade iron by means of charcoal, has for some considerable time discarded this locally produced fuel and is using coke. The iron produced has been of a special high grade and has found a good market, but the demand has eased somewhat of late, and the works are closed down temporarily. The iron ore trade is moderate. The steel trade is dull with few orders in the market, and many to share them. Shipbuilding is fair and engineering moderately busy.

SHEFFIELD.

(From our own Correspondent.)

More Activity in Finished Steel.

WHILE there is no general improvement to record in the steel trades of Sheffield and district, a little more activity is to be found in certain of the finished departments. This may, however, be due to the fact that, owing to the stoppage of production for the holidays, consumers had to lay in rather larger supplies than usual. The length of the holiday varied at different works. Some closed down for a week, but in other cases the suspension was for two or three days only. The open-hearth steel trade is as dull as ever, and only about a third of the furnaces in the district are in operation. There is a lack of orders for bulk quantities, and inquiries are also on the small side. The lighter sides of the trade are still busier than the heavy. The tonnage of corrosion-resisting steels produced in the city is large, and there is a good demand for certain other specialities, including automobile supplies and cold-rolled steel, although the volume of work is not up to the average of past years.

In Lincolnshire.

The steel works in North Lincolnshire, whose activities consist principally of the production of basic material, were much more fortunately placed than those of Sheffield until recently, but their position has shown a falling off during the greater part of this year, and the decline has been more marked in the last two or three months. The present output of the area is considerably less than that of twelve months ago. Lysaghts recently installed a new type of Italian furnace at their works at Scunthorpe, and this is now reported to be operating successfully, and giving much better results than the ordinary type.

Cheaper Pig Iron.

The buying of raw materials for steel making is stagnant. A good deal of pig iron has accumulated at the blast-furnaces, and the requirements of the foundries show a continued decline. Last week Derbyshire and Northamptonshire foundry and forge pig were reduced by 2s. 6d. per ton. Lincolnshire foundry and forge irons are off the market. The quantities being produced in that district are very limited, and it is reported that one of the few blast-furnaces still working on foundry iron there is to be damped down. Basic pig is by no means plentiful owing to reduced output.

Orders from Canada.

There is a good deal of activity at the Vickers works of the English Steel Corporation, which are busier than for some time past, and which only took a two days' holiday this week. Two substantial orders for forgings for Canada, received at these works, were reported a few days ago. The first is for very big forgings for chemical plants in British Columbia, with a total weight of about 500 tons. It is expected that they will be delivered in about five months. The second order is for some particular forgings which are to be made from Vickers' special alloy steels. It is hoped that the latter order will be the forerunner of a considerable amount of work.

Off to South America.

There is something more than usually interesting in the idea of a trade corporation with a history of over 300 years sending its principal officer across the Atlantic to the New World to preach the excellence of Sheffield goods, and in that ambassador being accompanied by the leader of the city's youngest trade organisation. This is what Sheffield has done by despatching its Master Cutler, Mr. A. K. Wilson, and the President of its Junior Chamber of Commerce, Mr. C. R. Hodgson, on a tour which will last some months, and which will include visits to Brazil, Uruguay, Argentina, Chile, and Peru. The Mistress Cutler is also of the party. The mission sailed from Southampton last Friday. Both its leaders are young men, full of enthusiasm, and there is every hope that the result of the visit will be beneficial to Sheffield trade. "The fact that Sheffield manufacturers as a body have shown a united front and been prepared to share the expense," said the Master Cutler on the eve of his departure, "is a sign of the new spirit and a good augury for the future. Since trade will not come to Sheffield, Sheffield must go to the trade. We are out to show the world that Sheffield trade is not stagnant, that our city is not decadent, and that our industry is as full of energy as ever. This mission is aimed at demonstrating the quality of Sheffield products and increasing our market. I am convinced that South America is easily the biggest potential market in the world for Sheffield goods. In cutlery, files, and saws Germany and the United States do a better trade than we do. Why this should be so and how it can be remedied is the main purpose of the tour."

Derby Projects.

Derby Town Council's great scheme for the building of public offices on a central site has been adopted in a revised form. It is not proposed to erect a new Town Hall at present, but the project is still a large one, as it embraces new municipal offices, police offices, fire and omnibus stations, market, &c. The estimated cost is £563,000, and it was stated at the Council meeting that extensive assistance would be forthcoming from the Unemployment Grants Committee. One consequence of the carrying out of the scheme will be the widening of Tenant-street to 90ft. The Corporation has also accepted a tender of £79,500 for the erection of the new Queen-street baths, one condition being that all the work, with the exception of the stone-work, shall be carried out in Derby.

Cutlery and Plate.

Old members of the cutlery and plate industry state that they have never experienced such a spell of bad trade as is now in existence. There has been a little improvement in some quarters recently, owing to the placing of a few good contracts, but on the whole conditions are seriously and widely depressed. The home demand for cheap goods shows a deep decline, and the sale of good-class silver and hollowware is very restricted. There are also several special reasons for the present state of things. One of them is the American and German competition in the safety razor blade trade. There is a tendency for prices of these articles to fall, and certain Sheffield firms are now producing blades to sell at 1d. or 1½d. each, in answer to the efforts of the Germans, who have combined to meet American competition. Sheffield's trade with the United States in safety razor blanks fell away to very small proportions last quarter. Another handicap which Sheffield is suffering from at present is that produced by the new Australian tariff and embargo. For years the Commonwealth has been Sheffield's largest customer, but now the sales of cutlery have dropped to the lowest level known for a long time, while, as the direct result of the new fiscal arrangements, it is said, hundreds of electro-plate workers are on short time.

NORTH OF ENGLAND.

(From our own Correspondent.)

Coal Trade Decline.

THE latest accountancy ascertainment concerning proceeds and costs in the Northumberland coal-mining industry shows a sharp decline in the economic position. The figures deal with the trading in June, when there was much lost time at the pits owing to the lack of orders. They show that miners' wages this month, if they had not had the protection of 40 per cent. on the basis rates, would be 10·52 per cent. on the basis, compared with 31·11 per cent. in July, a fall of 20·59 per cent. The coalowners have thus to make up a deficiency of 29·48 per cent. It is easily the lowest economic yield of this year, and much below the monthly average of 1929. Production was down nearly 270,000 tons, and costs have gone up by 11d. a ton, because of irregular working at the collieries. The Durham ascertainment shows a wage percentage of 36·26, compared with 47·93 in the preceding month. As this is less than the minimum percentage of 65 per cent. provided in the county agreement, this latter percentage will continue to apply to miners' wages during August. The figures for Durham County are not so bad as those for Northumberland, because Durham has a much steadier trade and is not so dependent on exports as Northumberland. Durham produces gas coal very largely, as compared with Northumberland's output of steam coal.

Cleveland Iron Trade.

The volume of business passing in the Cleveland pig iron trade is much lighter than is customary, even at this usually quiet period of the year. Foreign competition threatens to be keener than ever, reports from the Continent pointing to lower values, both in raw and finished material. Transactions are almost confined to small sales for home consumption, and customers press for price concessions. Producers, however, adhere to their fixed minimum quotations, and are of the opinion that concessions would not induce buying. No. 1 Cleveland pig iron is 70s.; No. 3 G.M.B., 67s. 6d.; No. 4 foundry, 66s. 6d.; and No. 4 forge, 66s.

Hematite Pig Iron.

Producers of East Coast hematite pig iron endeavour to take a firmer stand, but stocks are heavy and merchants do not hesitate to cut prices in their anxiety to unload their holdings, whilst comparative cheapness of continental hematite keeps products of this area out of markets abroad. Approximately, 100,000 tons of hematite, estimated to be lying at makers' yards, are a serious burden. A considerable amount is understood to be sold, but customers are unable to take up full supplies against running contracts. Makers base values on ordinary qualities at 71s.

Ironmaking Materials.

Business in foreign ore is virtually at a standstill, and consumers are unwilling to accept supplies as contract deliveries fall due. Imports to the Tees for the month of July amounted to 98,229 tons, as compared with 105,186 tons in June. Best Rubio remains nominally at 20s., c.i.f. Tees. Blast-furnace coke continues plentiful, and prompt parcels of good medium qualities are still obtainable at 16s. 6d. delivered at the works on the North-East Coast, but for forward contracts sellers hold out for much higher terms.

Manufactured Iron and Steel.

There is an absence of new features in the various branches of the manufactured iron and steel trade. One or two firms are busy on the construction of steamers, but specifications for shipbuilding requisites generally are not coming forward freely. Producers of railway material and of structural steel are turning out moderate tonnage, and sheet manufacturers are not badly off for work, but in all departments orders are needed. Prices are unaltered.

The Coal Trade.

The depression in the Northern coal trade is entirely unrelieved, and the outlook does not give much encouragement. Steam fuels, both in Northumberland and in Durham, have rather a better tone, but there is not sufficient business passing to affect prices to any appreciable extent. Best Northumberland is steady at 13s. 6d., and Tyne primes are worth from 12s. 6d. to 12s. 9d. Best gas coals are undisturbed, and in very moderate demand at 15s. Wear specials are similarly placed at 15s. 3d. to 15s. 6d. Bunker coals have a quiet tone, and lots are plentiful at 13s. to 14s. for best Durham, with second-class qualities ranging from 12s. 6d. to 12s. 9d. Gas coke maintains a firm position, and is quite a redeeming feature. Supplies are well taken up, and 21s. 6d. is confidently asked. Other grades are not so fortunately placed for present supplies, and while prices are steady, there is not a firm undertone. Forward, the position is considered to be more favourable. At 20s. to 22s. better grades are attracting a moderate inquiry.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE output from Clyde shipyards during the month of July was nine vessels of 31,852 tons aggregate. Included in the list were the following vessels:—Two oil tankers, one of 9000 tons and one of 8000 tons; a passenger and cargo vessel of 6000 tons, built for the Compania Sud Americana de Vapores, and a passenger vessel of 4000 tons, built for the same owners. The last-mentioned was built to Lloyds' highest class by William Hamilton and Co., Ltd., Port-Glasgow. This vessel is the tenth

built in the same yard for the Compania Sud Americana since the first keel was laid for it in 1874, and is the forty-third vessel built for the company in this country. The Clyde output for this year to date amounts to 125 vessels of 325,018 tons, against 132 of 323,939 tons in the same period last year. While the output has apparently been maintained, the outlook is none too promising when it is noted that the work in hand in Scottish shipyards is fully 100,000 tons less than in the March quarter this year. The number of vacant berths increases, new contracts being considerably fewer than launches. The only important contract reported during July was one for an oil tanker of 14,000 tons, to be built at Greenock for the Standard Oil Company, of New York.

Steel and Iron.

The majority of the works have just re-started, the holidays having been of longer duration this year owing to the general shortage of specifications. A fair commencement was achieved, but the work in hand does not allow producers to see more than a few days ahead. The inquiry is, perhaps, a shade better at the moment. Bar iron and re-rolled steel bars have ample room for improvement, the latter showing little life at £7 12s. 6d. per ton, home or export, while the former is more or less stagnant at £10 5s. home (fixed) and £9 15s. per ton export.

Pig Iron.

Thirteen blast-furnaces in Scotland have been blown out and will probably be idle until trade improves. The number left in blast is only twelve compared with upwards of eighty in pre-war years.

Scrap.

The scrap market continues easier in tone and prices remain round about 52s. 6d. for heavy steel and heavy basic and 65s. per ton for cast iron machinery.

Coal.

Apart from the slightly firmer attitude of Lanarkshire splints, which have become rather scarce, the market, on the whole, shows little change. Most qualities of large fuel are plentiful and prices are in most cases a matter of arrangement. Some collieries in Lanarkshire are still idle owing to lack of home demands, while those in Fifeshire and the Lothians feel keenly the dearth of export orders. Washed materials are comparatively steady owing to restricted supplies. Aggregate shipments amounted to 184,665 tons, against 87,190 tons in the preceding week, and 238,049 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THE holidays are accountable for the complete absence of any feature in the steam coal trade of this district, except that the conditions are unsatisfactory, with no promise of any immediate improvement. There was no loading pressure just before the vacation, and the returns of shipments last week were very disappointing. Still, that could not be otherwise, as, although no doubt everyone connected with the export trade did their best to get steamers loaded and sailed, so as to avoid vessels being detained over the holidays, with the risk of heavy demurrage, the fact remains that on Saturday there were as many as fifty idle tipping appliances at the six principal docks in this district, and even earlier in the week the number ranged about thirty. There was, of course, no work in the coalfield the first three days of this week, and no work at the docks so far as coal shipments were concerned on the two first days. The result was, therefore, that some collieries were a little better off for tonnage, as the result of arrivals over the week-end, but the improvement in the position generally was so meagre that the exceptional quantity of coals standing was more than sufficient in the case of large and small coals to meet requirements. The holidays, however, mean that practically half a week's output is lost, so that collieries should be able to reduce their standing stocks to an appreciable extent. Unfortunately, new business is practically stagnant, and there appears to be no prospect of expansion in operations at the moment. While the situation for the time being remains so dull, interest is certainly displayed regarding the forward position. In view of the passing of the new Mines Bill, it is very essential that no time should be lost in the parties getting together for the purpose of negotiating the new wages agreement for South Wales, more especially as, during the autumn, contracts for the supply of coal over the following year are considered and entered into. Such business may be held up, to the great disadvantage of this district, if the terms of employment are not agreed upon, and the coalowners and exporters know where they stand. There is, of course, much speculation as to what developments may take place, and it must be admitted that a feeling of uneasiness is prevalent, as it is quite impossible to say what may happen in the possible event of the coalowners seeking a reduction in wages to compensate for the reduced working hours in the coalfield.

Russia's Trading Operations.

Reference was made some time ago to the menace of Russia in the matter of the export from that country of anthracite coals. The position is as serious as ever, and it is evident that the situation is being borne in upon other countries besides our own. In fact, the whole of Russia's operations are being watched very keenly in this district, not only by coalowners but shipowners as well. The action of the American Government authorities in banning the discharge of steamers at American ports with cargoes of pulpwood last week created considerable interest, though, since then, the ban has been raised, but what concerned this district more closely was the step taken by the Canadian authorities in declining to permit the entry into a St. Lawrence River port of a British steamer with a cargo of pulpwood. The point is whether that step may not be followed by the Canadians taking measures later in the matter of anthracite coals shipped from Russia. It is well known that the Soviet Government has dumped its coal in Canada at a price which cannot be competed with, and should the Canadian authorities adopt action for the protection of their own miners and coal sellers, that would at the same time afford protection for the Welsh coal trade.

Wages in Tin-plate Trade.

The Joint Standing Committee of the Welsh Tin-plate Trade Joint Industrial Council met at Swansea on Thursday in last week, when the men's representatives were informed that in view of the recent sliding ascertainment showing an increase of 7 per cent., and also in accordance with the decision twelve months ago, when the sliding scale first became operative, employers had decided to discontinue the 2½ per cent. *ex-gratia* bonus to the higher-paid men after Saturday last. On behalf of the men it was pointed out that such action was very unfair, in view of the fact that trade was in a better condition now than it was twelve months ago. The ascertainment showed an increase of 7 per cent. to the men, but of necessity it also showed a much greater increase in profit to the employer. The employers, however, declined to alter their decision, and the men therefore decided to report the matter to their side of the Industrial Council. It should be pointed out that the 7½ per cent. *ex-gratia* bonus to the lower-paid workmen is being continued.

Current Business.

Quite apart from the holidays, the tone of the market is very quiet and inactive. Business is virtually at a standstill this week, and there is no promise of an improvement this month, which is usually the case during August. Sized coals are relatively the steadiest section, all other coals being offered freely at schedule minimum prices. Apart from the Newport Corporation being in the market for 30,000 tons to 60,000 tons of coal for its electricity works over the next six or twelve months, there is no inquiry of any note. Coal shipment operations are so much below the average that twenty tippers engaged at the Barry Docks have received notice from the Great Western Railway Company, though that may be only a temporary measure. Coke and patent fuel continue to be featureless sections, but pitwood keeps very steady. Supplies coming along are very restricted, though at the same time the demands of the collieries are at a comparatively low level at the moment. Nominally, the price is round about 29s.

Catalogues.

FERODO, Ltd., Chapel-en-le-Frith.—A sixty-page catalogue on brake and clutch linings.

JOHN FOWLER AND CO. (Leeds), Ltd., Leeds.—Particulars of plant for road-making and municipal work.

EDGAR ALLEN AND CO., Ltd., Imperial Steel Works, Sheffield.—Second edition of the K-B pulveriser pamphlet.

SULZER BROTHERS, 31, Bedford-square, W.C. 1.—Catalogue 4416 on "Sulzer Diesel Locomotives and Rail Cars."

PRATCHITT BROTHERS, Ltd., Denton Ironworks, Carlisle.—An illustrated leaflet showing the range of the firm's products.

BRITISH OXYGEN COMPANY, Ltd., Edmonton, London.—An illustrated brochure of the company's works at Edmonton.

GLOBE PNEUMATIC ENGINEERING COMPANY, Ltd., 1, Victoria-street, S.W. 1.—"Pneumatic Tools and Air Compressors."

DRAYTON REGULATOR AND INSTRUMENT COMPANY, Ltd., West Drayton, Middlesex.—A leaflet on dial thermometers.

COVENTRY CHAIN COMPANY, Ltd., Coventry.—A booklet, "Installation and Maintenance of Coventry Chain Drives."

T. C. HOWDEN AND CO., 5, Fleet-street, Birmingham.—Abridged catalogue 31E of Amsler testing machines and instruments.

BRITISH STEEL PILING COMPANY, Ltd., 54A, Parliament-street, S.W. 1.—An illustrated list of contracts carried out using Vibro concrete piles.

WAILES DOVE BITUMASTIC, Ltd., Collingwood Buildings, Newcastle-on-Tyne.—A booklet on "Bitumastic" protection for pipe lines.

EDGAR ALLEN AND CO., Ltd., Imperial Steel Works, Sheffield.—The third revised edition of the "Edgar Allen Steel Foundry Book."

LIVERPOOL ELECTRIC CABLE COMPANY, Ltd., Linacre-lane, Bootle, Liverpool.—Catalogue of "Liverpool" paper-insulated low-tension cables.

GRAPHITE PRODUCTS, Ltd., 218, Queen's-road, S.W. 8.—A 45-page booklet giving particulars of "Foliac" graphite and other products of the firm.

MIDGLEY AND SUTCLIFFE, Richmond-road, Bradford.—A leaflet illustrating the "Richmond" high-speed radial drilling machine, models 8 and 8a.

JOHN HOLROYD AND CO., Ltd., Milnrow, near Rochdale.—A catalogue showing with the aid of sketches the advantages of "Holfos" and worm gears.

JAMES GORDON AND CO., Ltd., Windsor House, Kingsway, W.C. 2.—Particulars of the Hagen automatic system of combustion control and gas regulation.

SOCIETE D'EXPLOITATION DES PROCEDES DABEG, 4, Rue du Général-Foy, Paris (8e), France.—Dabeg Bulletin No. 2, containing a list of conversion factors.

WILD BARFIELD ELECTRIC FURNACES, Ltd., North-road, N. 7.—A folder on ovens with forced air circulation for the tempering of tools, machine parts, &c.

BRAITHWAITE AND CO. (ENGINEERS), Ltd., Broadway Buildings, S.W. 1.—A booklet illustrating the firm's work in connection with jetties, piers and pipe lines.

ALFRED HERBERT, Ltd., Coventry.—"Flue Gas Purification," a publication dealing with apparatus for the removal of dust and sulphur from flue gases (Modave's patents).

SIR W. G. ARMSTRONG, WHITWORTH AND CO. (ENGINEERS), Ltd.—A brochure dealing with the economics of Diesel-electric traction illustrating some units in operation.

BURTON, GRIFFITHS AND CO., Ltd., Montgomery-street, Sparkbrook, Birmingham.—A leaflet showing a new type of gauge for fillets and radii made by Brown and Sharpe.

VACUUM OIL COMPANY, Ltd., Caxton House, Westminster, S.W. 1.—No. 34 of the Gargoyle Technical Series, "High Grade Lubricating Greases: Their Uses and Application."

GALLOWAYS LTD., Manchester.—A detailed description of the "Supermiser" with a list of users and the official report of a test on a "Supermiser" fitted to a Lancashire boiler.

ALLOY WELDING PROCESSES, Ltd., Ferry-lane Works, E. 17.—Particulars of "A.W.P." special alloying electrodes for the welding of corrosion and heat-resisting steels and alloys.

HOLMAN BROS., Ltd., Camborne.—Particulars of a rubber collar for preventing drill steel breakages. A description of the 4a levergrip sharpener and a general catalogue of the firm's products.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—The following publications: H 120, "C.T.S. Wiring System"; H 121, "Helsby Twin Wiring System"; H 122, "Helsby Bond Wire System."

"ERIC" ENGINEERING COMPANY, Chepstow, Mon.—A brochure showing the various appliances made by the firm for the scraping, cleaning and electrical re-coating of water mains, sewers and other pipe lines.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

DAVID SCOTT AND CO., Ltd., of 493, Aitkenhead-road, Polmadie, Glasgow, notify us that they have removed to 155, Broomloan-road, Govan, Glasgow, as from July 12th, 1930.

MR. W. L. HICHENS, who accepted the chairmanship of the English Electric Company in October, 1927, as a temporary arrangement, has resigned that office and retired from the board now that the reconstruction of the company has been completed. Sir Holberry Mensforth, K.C.B., C.B.E., has been elected to the board and appointed chairman of the company.

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., asks us to announce that it has opened new offices at Ship Canal House, King-street, Manchester. Telephone Nos., City 6230/1/2; telegraphic address, "Multiphase, Manchester." A new depôt has also been opened for the sale of "Cosmos" lamps at 3, Victoria Bridge, Manchester, to which address it is requested that all inquiries and correspondence connected with those lamps should be directed.

CONTRACTS.

JAMES POLLOCK, SONS AND CO., Ltd., 3, Lloyd's-avenue, London, and Faversham, have received an order from the Thames Conservancy to build a single-screw steel motor tug, length 32ft. 6in., breadth 9ft., depth 4ft. 6in., which is to be fitted with a 54 B.H.P. "Gardner" three-cylinder heavy-duty engine.

EAST FERRY ROAD ENGINEERING WORKS COMPANY, Ltd., of Millwall, London, E. 14, has received from the Port of London Authority an order for a set of hydraulic pressure pumping engines having a capacity of 350 gallons per minute at a working pressure of 800 lb. per square inch, with a steam pressure of 145 lb. per square inch at the engine stop valve and a speed of 30 revolutions per minute. The engines are to be of the horizontal, tandem, compound, condensing type with the steam cylinders in line, each pair actuating two single-acting pump rams. There are two sets of these cylinders and rams, either of which can be laid off at will without interfering with the running of the other. An interesting point about this order is that the new plant is to replace a set of engines supplied by the same company to the old Millwall Dock Company no less than forty-four years ago.

A LARGE CAST IRON PROPELLER.—What is believed to be the largest cast iron one-piece propeller yet made on the North-East Coast was recently completed by Smith and Co. (South Shields), Ltd., of South Shields, for John G. Kincaid and Co., Ltd., of Greenock. The propeller weighs 16½ tons and it has a diameter of 20ft. with a total surface area for the four blades of 108 square feet. Only five days were occupied in moulding and casting the propeller, which is a tribute to the efficiency of the firm's workmen and plant. The propeller will be transported to the engine builders' works at Greenock by road, and will there be machined before fitting on a ship under construction on the Clyde.

THE OFFICE MACHINERY USERS' ASSOCIATION.—A copy of the volume of the "Transactions" of the Office Machinery Users' Association for 1929–30 has just reached us. In additon to the foreword by the Chairman on "The O.M.U.A. and what it Stands for," reports are given of the various lectures and demonstrations which took place at the London School of Economics during the year's session. The volume concludes with an announcement of the fixtures for the autumn session commencing on October 8th next at the London School of Economics. Particulars as to membership of the Association may be obtained on application to the Secretary, Mr. S. W. Rowland, F.C.A., Lincoln House, 296–302, High Holborn, London, W.C. 1.

A NEW METALLIC HEAT INSULATING MATERIAL.—We recently inspected examples of "Alfol," a patented metallic heat insulating device, which is supplied in this country by Alfol Insulation, Ltd., 216–218, Windsor House, Victoria-street, London, S.W. 1. It consists of very thin sheets of highly polished pure aluminium foil, which have a thickness of only 0·007 mm. In service these sheets are lightly crumpled, a process which is aided by the embossed diamond-shaped trade mark design. They are then placed over one another so that only the ridges of the various layers touch each other. When so applied the weight per cubic foot of insulation is only 3 oz. The outer layer is protected by a strong cover or by steel lagging in the usual way. It is claimed that the high heat-reflecting power of the bright metal surfaces combined with the low conductivity of the separated air-filled spaces between the layers, effectively prevents loss of heat by radiation or convection, while heat loss by conduction is rendered practically negligible owing to the extraordinary thinness of the foil, and the fact that the different layers only touch each other at intervals. According to tests which have been made at the National Physical Laboratory at Teddington, with a 2in. "Alfol" insulation around a pipe 4·49in. in diameter, with a temperature difference between the pipe surface and the outside air of between 530 deg. to 730 deg. Fah., the saving in radiation loss compared with the bare pipe without any insulation was from 94 to 95 per cent. Another N.P.L. test at a temperature of 37 deg. Fah. gave a figure of conductivity of 0·29 B.Th.U. per 1in. thickness per square foot per hour per degree Fah. difference. It is also of interest to note that the radiation from "Alfol" is only 4 to 5 per cent. of that from a black body. "Alfol" foil has, in high temperature installations, been successfully employed, we are informed, on high-pressure locomotives, boiler and funnel casings, land and marine turbines, and low-temperature carbonisation plants, while for low temperatures, it has been equally effectively used on insulated motor wagons and railway cars, where its lightness and resistance to vibration have proved highly advantageous.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast,	
(1) Native	17/9 to 20/6
(1) Spanish	20/6 to 21/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	20/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 19 6	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 16 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 10 0	3 10 0
Siliceous Iron	3 10 0	3 10 0
No. 3 G.M.B.	3 7 6	3 7 6
No. 4 Foundry	3 6 6	3 6 6
No. 4 Forge	3 6 0	3 6 0
Mottled	3 5 6	3 5 6
White	3 5 6	3 5 6
Midlands—		
(e) Staffs —	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 8 6	—
„ „ Foundry	3 13 6	—
(e) Northampton—		
Foundry No. 3	3 10 0	—
Forge	3 5 0	—
(e) Derbyshire—		
No. 3 Foundry	3 13 6	—
Forge	3 8 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 11 0	—
No. 4 Forge	3 7 0	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 3 6 (*a*); 4 6 6 (*b*); 4 10 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	12 15 0	12 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 17 6 to 8 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 15 0	—
Sheffield—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 10 0	—
Hoops	9 15 0 to 10 0 0	—
Soft Wire Rods	8 0 0	—
Midlands—		
Small Rolled Bars	7 17 6 to 8 10 0	—
Billets and Sheet Bars	5 17 6 to 6 5 0	—
Galv. Sheets, f.o.b. L'pool	11 17 6	—
(2) Staffordshire Hoops	10 0 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/– to 18/1½
Block Tin (cash)	136 17 6
„ (three months)	138 7 6
Copper (cash)	48 15 0
„ (three months)	48 15 0
Spanish Lead (cash)	18 5 0
„ „ (three months)	18 6 3
Spelter (cash)	16 15 0
„ (three months)	17 2 6
Manchester—	
Copper, Best Selected Ingots	52 10 0
„ Electrolytic	52 10 0
„ Strong Sheets	79 0 0
„ Tubes (Basis Price), lb.	0 0 11½
Brass Tubes (Basis Price), lb.	0 0 10½
„ Condenser, lb.	0 1 0½
Lead, English	19 17 6
„ Foreign	18 5 0
Spelter	16 15 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	For Unit.
Tungsten Metal Powder	2/8½ per lb.	
Ferro Tungsten	2/5½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 12 6	7/–
„ „ 6 p.c. to 8 p.c.	£22 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£22 0 0	7/–
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 10 0	10/–
„ „ „ 1 p.c. carbon	£38 0 0	13/6
„ „ „ 0·70 p.c. carbon	£39 0 0	15/–
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
„ „ „	£11 0 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/– per unit	
„ „ 75 p.c.	£19 0 0 scale 7/– per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	12/6
„ „ Ell	13/–
„ „ Splint	14/– to 15/6
„ „ Trebles	12/– to 12/6
„ „ Doubles	11/9 to 12/–
„ „ Singles	11/3 to 11/6
Ayrshire—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	16/–
„ „ Trebles	13/–
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	10/9 to 12/–
Screened Navigation	16/6 to 17/6
Trebles	13/– to 13/6
Doubles	12/– to 12/6
Singles	11/9 to 12/–
Lothians—	
(f.o.b. Leith)—Best Steam	11/6
Secondary Steam	11/–
Trebles	12/6 to 13/–
Doubles	12/– to 12/6
Singles	11/6

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		20/6 to 21/–
Household		32/– to 51/–
Coke		20/– to 21/–
Northumberland—		
Best Steams		13/6
Second Steams		12/–
Steam Smalls		10/– to 10/6
Unscreened		12/6
Household		25/– to 37/–
Durham—		
Best Gas		14/9 to 15/–
Second		12/9 to 13/–
Household		25/– to 37/–
Foundry Coke		24/– to 26/–
Sheffield—		
Best Hand-picked Branch	24/– to 25/6	—
Derbyshire Best Bright House	19/– to 21/–	—
Best House Coal	18/– to 19/6	—
Screened House Coal	16/– to 17/–	—
„ „ Nuts	14/– to 16/–	—
Yorkshire Hards	14/– to 15/6	—
Derbyshire Hards	14/– to 15/6	—
Rough Slacks	8/6 to 9/–	—
Nutty Slacks	7/– to 8/–	—
Smalls	3/– to 5/–	—
Blast-furnace Coke (Inland)	15/6 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.		17/– to 18/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	20/–
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/– to 18/3
Best Eastern Valley Large	17/9 to 18/–
Ordinary Eastern Valley Large	17/6 to 17/–
Best Steam Smalls	13/6 to 14/–
Ordinary Smalls	12/6 to 13/–
Washed Nuts	19/– to 22/–
No. 3 Rhondda Large	20/– to 20/6
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	16/– to 16/6
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	27/6 to 37/–
Furnace Coke (Export)	21/– to 21/6
Patent Fuel	22/–
Pitwood (ex ship)	28/9 to 29/3
Swansea—	
Anthracite Coals :	
Best Big Vein Large	35/– to 37/6
Seconds	27/6 to 31/6
Red Vein	23/6 to 27/–
Machine-made Cobbles	41/6 to 45/–
Nuts	40/– to 46/–
Beans	24/6 to 27/6
Peas	20/– to 21/–
Breaker Duff	10/– to 10/6
Rubbly Culm	12/6 to 13/–
Steam Coals :	
Large	19/6 to 20/6
Seconds	18/– to 19/6
Smalls	12/– to 13/–
Cargo Through	15/6 to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country stations.

French Engineering Notes.

(From our Correspondent in Paris.)

The Steel Trade.

THE labour shortage and the activity in building and public works enabled this country for a long while to resist the depressing influences of foreign markets, but that resistance is now giving way, and the steel industry is on the down grade of lessening consumption and falling prices. The absence of unemployment has concealed the seriousness of the situation. It was nevertheless foreshadowed some months ago when efforts were made to push forward the national programme of public works in order to provide employment to iron and steel consumers. This is being delayed through the somewhat complicated character of the financial arrangements and also by the steadily advancing prices of manufactured products, which, it is feared, will rise still further if too many contracts are placed on the market at the same time. An artificial inflation would make the public works too costly and might be followed eventually by a serious collapse. One of the reasons why the Conseil Supérieur des Chemins de Fer reduced the volume of orders for rolling stock, is the tendency of wagon builders to advance prices under cover of the monopoly they now enjoy by arrangement with the newly-formed International Wagon Builders' Union. That, however, does not explain the high prices prevailing elsewhere. They are due to the conviction of manufacturers that they are unable to count upon what is likely to happen in the early future. The social insurance scheme, which has just been put into operation, has caused even more trouble than had been expected, for it has coincided with an increase of living costs and, in many cases, workers refuse to contribute their share to the fund. There have been many strikes, and one is now proceeding amongst the metal workers at Lille and the weavers at Roubaix, who claim an advance in wages equal to the amount deducted for insurance. In some cases manufacturers prefer to avoid trouble by taking the whole burden on themselves, which means an addition to overhead charges and higher selling prices. There is, consequently, a restriction of business which has rarely fallen to so low an ebb as it has now reached. In these circumstances there is less iron and steel going into consumption, and in the hope of arresting the decline in prices, mill and forge owners are endeavouring to arrange for a restriction of output and a minimum level of prices. If they do that they will be more successful than the Cartel, which is having a lot of trouble with the foreign steel trade, and, notwithstanding the control of prices of semi-manufactured steel and steel sections, it is affirmed that steel is being offered for export at below the official minimum. The partial reorganisation of the export trade in steel has not removed the feeling of doubt and scepticism as to whether it is possible to come to some really satisfactory agreement amongst producers in different countries at a time when they must dispose of stocks in order to avoid a still further reduction of output. The difficulties in the way of the Cartel are obviously increasing, and the next four months will show whether the steel trade will be reorganised or will be left to its fate.

The Concorde Bridge.

The widening of the Concorde Bridge in Paris is so far advanced that it is now possible to see the methods being adopted to carry out the work. On account of the position of the bridge in relation to the Chamber of Deputies and the Place de la Concorde its axis could not be changed, and the bridge, which is being widened by 66ft., had to be extended equally on both sides. The work had to be done without interfering with the vehicular traffic, and a passenger footbridge was constructed alongside. Owing to the loose character of the soil, which is waterlogged at a level with the river, sheet piling was driven in behind the new abutment works and was withdrawn on their completion. Three of the abutments are finished and the fourth is under construction. The existing five piers are built on wood piles driven down to the chalk, but since their construction 140 years ago the river has scoured out the bed under the arches and it was therefore found desirable to build the pier extensions on concrete foundations to a depth of 13ft. below the bed. Timber work was erected around the piers to support the metallic frames for the arches and the rectangular caissons during erection, these latter being suspended from the timbers by threaded bars and nuts. The caissons are lowered and raised by screwing the nuts on the bars. Some of the piers are now completed, and work has been started on the arches on the up-river side. In order to lessen as much as possible the load on the old bridge the extension arches will be merely covered with a light platform of reinforced concrete. The Concorde Bridge will have the same facings, so that, except for the increased width, its appearance will remain unchanged. It is popularly believed that the old bridge was built with masonry from the demolished Bastille.

Flood Protection.

A serious trouble with the Isère, Drac, Romanche and other Alpine rivers is that the freshets in the spring bring down considerable quantities of boulders which raise the river beds and cause floods that are increasingly disastrous to the surrounding country, despite costly measures of protection. The banks of the Isère have been repeatedly raised, but the water seeps through them and floods a large area. All kinds of proposed remedies have been examined, even to crushing the boulders so that they can be swept away by the torrent, but it has been finally decided that the only practical solution is to dredge the river beds, raise and strengthen the banks and provide means for rapidly carrying away water from the areas liable to be flooded. A scheme of this kind has been prepared. It involves, in addition to the works mentioned, the construction of dykes for the protection of low-lying country and the erection of flood areas and reservoirs which will receive the overflow and return it to the river when the floods have subsided. In this way the floods will be localised without causing extensive damage. The Government has authorised an expenditure upon these defensive works of 260 million francs. They will be carried out by an association in Grenoble representing syndicates that will be formed in the various districts.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

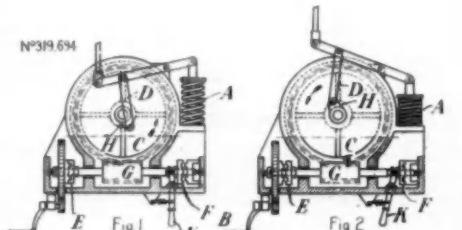
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

SWITCHGEAR.

319,694. September 24th, 1929.—OPERATING MECHANISM FOR ELECTRIC CIRCUIT BREAKERS, Allmänna Svenska Elektriska Aktiebolaget, of Västeras, Sweden.

This invention relates to operating mechanism for electric circuit breakers of the type in which a spring is set under tension by hand or by means of a motor and when released closes the circuit breaker. The opening of the circuit breaker is, on the contrary, effected by so-called free release, independent of the closing mechanism. For setting the spring A under tension the screw gearing is rotated by means of the crank B, or by a motor, so as to cause the worm wheel C to rotate in the direction of the arrow from the position shown in Fig. 1 to the position shown in Fig. 2. The crank D is thus moved a little over its top point, and if the circuit breaker is not to be closed at once, it is then locked. When the closing is to be effected, the worm wheel C is allowed to continue its movement in the direction of the arrow to about the position shown in Fig. 1. The spring is released during the continued movement of the wheel C and

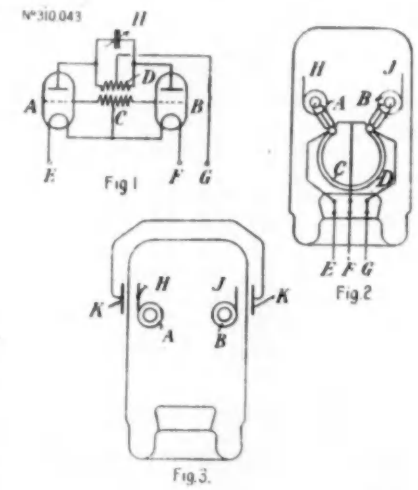


closes the circuit breaker, the motion of the mechanism being retarded by the gearing. The worm G is displaceable in the longitudinal direction and connected to two disengaging couplings E, F. The coupling E is engaged when the worm G is moved to the left so as to connect up the driving means B, while the coupling F, which is engaged at a displacement in the opposite direction, connects the worm either to a fixed part or to a disc influenced by a brake. During the movement for setting the spring A under tension, when the tooth pressure from the worm wheel C acts on the worm G towards the left, the coupling E is kept in engagement so that the worm is connected to the driving means B. When the crank B is operated, H passes its top point, the direction of the tooth pressure is reversed, whereby the coupling E is disengaged and the coupling F is engaged, so that the gearing H stops in the position shown in Fig. 2. In order to release the spring A and thus close the circuit breaker, the coupling F can then be disengaged by means of a hand lever K.—*July 3rd*, 1930.

TELEGRAPHS AND TELEPHONES.

310,043. April 18th, 1928.—HIGH-FREQUENCY THERMIONIC GENERATORS, Telefunken Gesellschaft fur drahtlose Telegraphie m.b.H., of 12/13, Hallesches Ufer, Berlin, Germany.

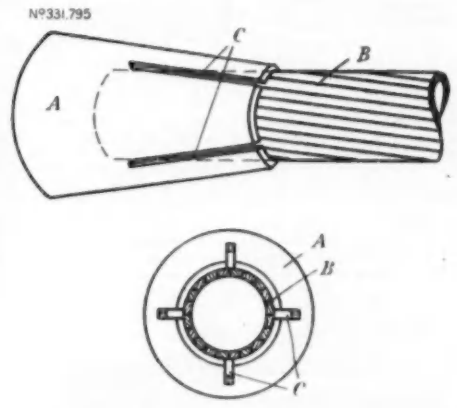
In the generation of very short waves the conductors connecting the various circuit elements of the generator become of importance owing to the highly disturbing factor introduced by their capacity and inductance. Up to a frequency of about 50,000 kilocycles, generation is still practicable with normal circuit elements arranged exterior to the valves, but above that frequency the conductor capacity and inductance reactances reach such high values that any substantial increase of frequency becomes impracticable. Accordingly the inventor uses a thermionic



generator for extremely high frequencies, in which all capacities and inductances not directly appertaining to the oscillating circuit are avoided by enclosing the whole of the circuit elements, including the oscillating circuits, in an evacuated glass envelope and in which variation of the frequency is effected by capacitative or inductive influence from the exterior of the envelope. In the drawings Fig. 1 shows the theoretical diagram of a short-wave generator in push-pull connection, whilst Fig. 2 shows one arrangement in accordance with the invention of the circuit elements represented in Fig. 1. Referring to Fig. 2, the two electrode systems A and B, which are fused on to glass bridges, are connected directly with the inductances C and D. The conductors E, F, G for supplying cathode heating and anode potentials are passed through the glass footstep to the exterior. Variation of the frequency may be effected by capacitative means, for example, by two plates H and J, welded on to the anodes, the plates being in capacitative relation with an external plate-cylinder K—Fig. 3.—*July 10th*, 1930.

331,795. November 26th, 1929.—DEEP SEA CABLES, Felten and Guilleaume Carlswerk Aktien-Gesellschaft, of Köln-Mülheim, Germany.

To resist the water pressure deep sea cables are provided with pressure-protecting means consisting of a hollow rope formed of laid section wires. This hollow rope is not completely rigid, but decreases in diameter as the pressure increases. Although this decrease in the diameter is only slight, it causes a small gap to form at the place where the hollow rope, for instance, enters the rigid branch of the pressure-resisting body of a pupin coil sleeve, which may be the cause of a deformation of the outer lead sheath and consequently of a leakage. The

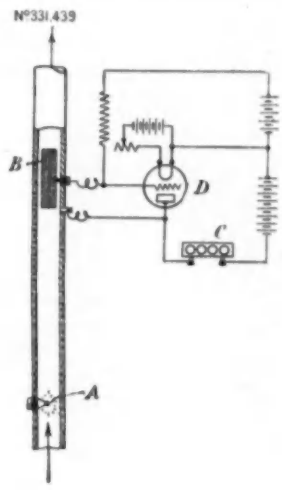


object of the invention is to provide means for giving the leading-in end of the pressure-resisting body of the pupin coil sleeve the property of decreasing its diameter as the water pressure increases. This may be effected by a number of longitudinal slots sawn into the branch parallel to the axis of the sleeve end, the slots being filled with a relatively soft compressible material, for instance, lead. The diameter of such a sleeve end will decrease where it merges into the hollow rope to the same extent as the hollow rope under the action of the water pressure, a portion of the lead in the slots being forced out. In the constructional example shown, A is the leading-in end of the pressure-resisting body, B the protective rope of the cable and C the longitudinal slots.—*July 10th*, 1930.

MEASURING AND TESTING INSTRUMENTS.

331,439. September 13th, 1929.—A GAS METER, *Humphreys and Glasgow, Ltd.*, 38, *Victoria-street, London, S.W.* 1.

The broad principle of this meter is to ionise the gas and to measure its electrical conductivity. The gas passes a source of radio-activity, such as radium, at A. It is consequently ionised



and the proportion of ions which reach the insulated anode B in an active state will depend upon the rate of flow of the gas. The conductivity of the gas at the anode is determined by the passage of a current between the anode and the tube, and this current is registered by the ammeter C working in conjunction with the amplifying valve D.—*July 3rd*, 1930.

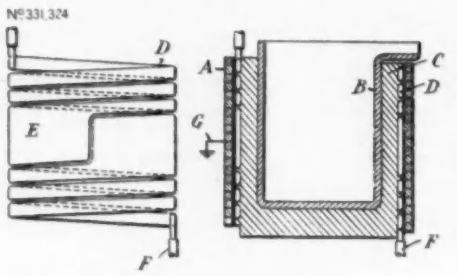
FURNACES.

331,324. May 8th, 1929.—ELECTRICAL INDUCTION FURNACES, Neville Ryland Davis, of "Inverclov," Ashton-lane, Sale, Chester, and Associated Electrical Industries, Ltd., Bush House, Aldwych, Westminster.

According to this invention, a screen or grid, constructed of tubular or hollow parts so that a cooling fluid can be circulated through it to carry off heat, is arranged between the charge and the inductor coil, core, if any, and frame, to prevent these latter parts becoming excessively heated by heat developed in and dissipated by the charge. The screen is insulated from the inductor coil and may conveniently be embedded in the furnace lining. The screen or grid is so constructed that it does not present a continuous electrical circuit embracing the charge and perpendicular to the magnetic field linking the charge. By such arrangement and by proper proportioning of the tubular parts the development of heat in the screen or grid, when the furnace inductor is energised, may be substantially prevented. A cylindrical furnace inductor coil as shown at A is provided with a lining comprising a crucible B and lagging C, between the crucible and the inductor coil. Embedded in the lagging close to the interior surface of the inductor coil is a screen D, which, as shown, takes the form of a helix of flattened metallic tube having an oval cross section. The convolution E of the helix which lies about the middle of the inductor coil may have a

considerable section, so that, as shown, it extends axially over a little more than the middle third of the length of the inductor coil. Rubber hose connections F are attached to the endmost convolutions of the helical screen, through which cooling fluid may be supplied and withdrawn. The rubber hose connections provide sufficiently good insulation to prevent an effective

No 331,324

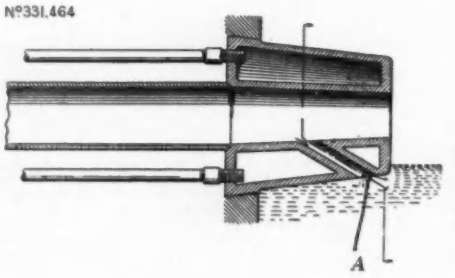


closed circuit being formed through the helical screen. The mid point of the screen may, if desired, be connected to earth as indicated at G, so that the maximum voltage between any point of the screen and earth is limited to one-half of the total voltage set up between the ends of the screen by the alternating magnetic flux of the furnace inductor coil.—*July 3rd*, 1930.

331,464. October 30th, 1929.—Blast-furnace Tuyeres, E. H. Holzworth, 111, Parker-avenue, Buffalo, New York.

The object of this invention is to prevent the burning of the nose of a blast-furnace tuyere through its contact with the bath

No 331,464



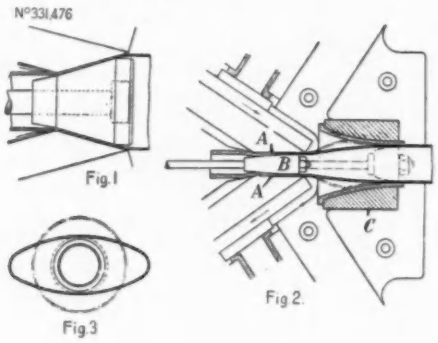
of molten metal. This is effected by providing a passage A in the bottom of the tuyere, through which part of the blast escapes. This blast agitates the molten metal and prevents it from adhering to the tuyere or gathering around its nose.—*July 3rd*, 1930.

MACHINE TOOLS AND SHOP APPLIANCES.

331,476. January 16th, 1930.—Expanding Metal Tubes, Mannesmannröhren-Werke, 1b, Berger Ufer, Dusseldorf, Germany.

The object of this invention is to avoid the variations in the thickness of rolled tubes caused by the displacement of the mandrel due to changes of temperature. Instead of using the inclined conical rolls, as shown in Fig. 1, the inventors use rolls with parallel working faces A A—see Fig. 2. These rolls work in conjunction with a slightly tapered mandrel B. Preferably the larger end of the mandrel is of a diameter which ensures the

No 331,476

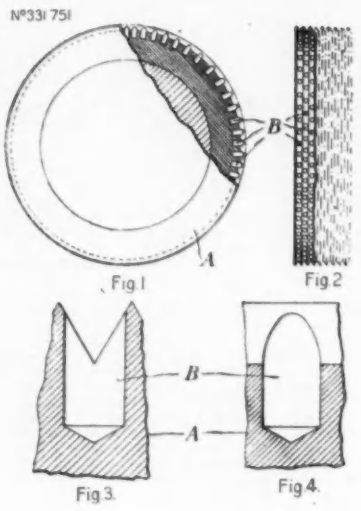


required reduction in thickness of the walls of the tube. The working length of the mandrel is dependent, on the one hand, upon the circumference of the expanded tube and, on the other hand, on the circumferential speed of the rolls; that is to say, the stretching of the circumference of the tube must increase as the tube passes the rolls at about the same rate as the rate of increase in circumferential speed of the working faces of the rolls in order that the tube may not be twisted. The effect of this process is to produce an oval tube—see Fig. 3—but this tube is subsequently forced through a tapered die C, which converts it into a circular cross section.—*July 3rd*, 1930.

331,751. September 5th, 1929.—Rollers for Trueing Ribbed Grinding Discs, H. Lindner, 57–58, Fruchtstrasse, Berlin, O. 17, Germany.

The trueing of ribbed grinding discs for making screw threads and the like is effected by means of correspondingly ribbed rotary trueing rollers. It often happens that the ribs of the grinding roller get fractured by the dust which accumulates in the grooves between the ribs and gets fixed to the roller. The object of the present invention is to obviate this disadvantage, and the invention consists in providing the roller surface with wells in the form of bore-holes wherein the dust can be trapped in loose condition, and whence it can thus be discharged by the rotary motion of the roller. The trueing roller A is made of a hard substance, such as a cobalt or tungsten alloy, and is grooved circumferentially, so as to form ribs whereby the corresponding ribs of the grinding disc for making screw threads or the like are trued. Bore-holes B are formed in the roller surface so as to produce wells wherein the dust from the grinding disc can be trapped and prevented from getting fixed in the grooves and cause a fracture of the ribs of the grinding disc. The bore-holes are preferably made in the grooves between the ribs and are spaced irregularly so as to prevent them from forming an uneven grinding surface. Preferably the holes are also staggered relatively to the holes of adjacent grooves. The diameter of the holes is preferably slightly less than the distance from centre to centre of the ribs. The holes being made in the

No 331,751



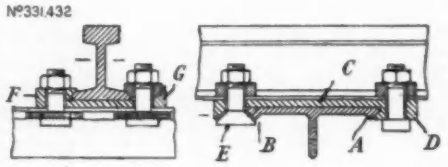
grooves, their upper edges extend in curves over the faces of the ribs—as shown in Fig. 4—and the dust will thus be easily caught in the holes and prevented from getting fixed in the grooves themselves.—*July 10th*, 1930.

TRAMWAYS AND RAILWAYS.

331,432. September 2nd, 1929.—Metal Sleepers, F. Heinemann, Muhlendamm 43, Hamburg, Germany.

The objects of this invention appear to be to obviate the necessity for piercing metal sleepers for the attachment of the rails and to provide a fastening which can be conveniently accommodated to the increased gauge round curves. The

No 331,432



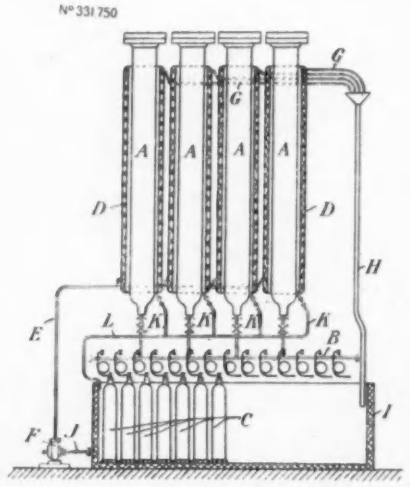
sleeper has two sloping faces A and B, of which that at B is serrated. Between the rail and the sleeper there is a plate C which engages the sleeper by the projection D on one side and by the conical bolt E on the other side. The rail is held to the plate by the projection F and the conical washer G.—*July 3rd*, 1930.

MISCELLANEOUS.

331,750. September 3rd, 1929.—Processes and Apparatus for Liquefying Solid Carbon Dioxide, Maschinenfabrik Esslingen, Esslingen, Germany, and J. Stoffels, Bismarckstrasse 48, Esslingen.

This invention relates to processes and apparatus for liquefying solid carbon dioxide. It has, say the inventors, been proposed to transport carbon dioxide in solid condition to great distances and to melt it and run it off into steel vessels for further use only when it has reached its destination. For this purpose the solid carbon dioxide must be brought to the melting point by heat supplied from the exterior. According to the invention, the quantities of cold extracted from the solid carbon dioxide

No 331,750



during the melting process are utilised to cool the receiving vessels into which the carbon dioxide is run as it is melted. It is essential to cool the receiving vessels for the melted carbon dioxide when the surrounding temperature is high—for example, in tropical countries, since otherwise it is impossible to run the liquid carbon dioxide into them. The utilisation of the cold extracted from the melting drums containing the solid carbon dioxide, in accordance with the invention, makes the procedure commercially practicable for the first time. If a circulating liquid is used as the cold carrier, the procedure is greatly accelerated, as the absorption of cold from the melting drums proceeds much more rapidly in this manner than with air absorption. The solid carbon dioxide is liquefied in high-pressure drums A, from which it is led in liquid condition through the tube B to the receiving vessels—steel drums—C, the high-pressure drums being mounted for this purpose at a suitable height above the receiving vessels. The drums A are surrounded with clearance by cylindrical jackets D, into which a liquid that is non-freezing at the low temperatures involved—for example, brine or alcohol—is led through the tubing E. The non-freezing liquid is pumped up into the jackets D by the pump F, so that it flows along the walls of the melting drums, and runs through the tubes G from the jackets to a common conduit H, by which it is led into the tank I in which the receiving vessels C are mounted. The non-freezing liquid is sucked out of the tank I by the pump F through the conduit J, and thereafter again goes through the same cycle. For emptying the jackets D tubes K are connected to the lower ends of the jackets, which convey the contents of the latter through a common conduit L into the tank I. The receiving vessels are gradually brought, by the circulating non-freezing liquid, to the same temperature as the melting drums, the procedure being regulated in such manner that the receiving vessels are filled with liquid carbon dioxide when this equality of temperature is reached.—*July 10th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

WEDNESDAY TO WEDNESDAY, SEPTEMBER 3RD TO 10TH.

British Association for the Advancement of Science.—Bristol meeting. The presidential address, by Professor F. O. Bower, will deal with "Size and Form in Plants." Evening discourses will be given by Professor E. V. Appleton, F.R.S., on "Wireless Echoes," and by Dr. R. E. Slade on "The Nitrogen Industry and our Food Supply." Evening receptions and excursions to points of scientific interest, works, &c., in the locality will be arranged.

THURSDAY TO SUNDAY, SEPTEMBER 4TH TO 7TH.

International Congress of Consulting Engineers.—Fifth Congress at Vienna.

TUESDAY TO FRIDAY, SEPTEMBER 9TH TO 12TH.

Institute of Metals.—Annual autumn meeting, Southampton. Continued from September 13th to September 16th by a visit to France. The meetings at Southampton will be held in the Chantry Hall, and on September 9th Professor D. Hanson will read a paper on "The Use of Non-ferrous Metals in the Aeronautical Industry." 8 p.m. **For programme see page 88.**

SATURDAY, SEPTEMBER 13TH, TO SATURDAY, SEPTEMBER 20TH.

Liverpool.—Centenary celebrations of the Liverpool and Manchester Railway.

SUNDAY TO WEDNESDAY, SEPTEMBER 14TH TO 17TH.

Newcomen Society.—Summer meeting at Liverpool.

FRIDAY TO SUNDAY, SEPTEMBER 19TH TO 21ST.

Women's Engineering Society.—Lady Margaret Hall, Oxford. Eighth annual conference.

FRIDAY, OCTOBER 31ST.

Overhead Lines Association.—Annual conversazione.

The New Sloop H.M.S. "Scarborough."—The new sloop H.M.S. "Scarborough," which has recently been delivered by Swan, Hunter and Wigham Richardson, Ltd., of Wallsend-on-Tyne, underwent successful power and speed trials off the mouth of the Tyne and then proceeded to Chatham. She is a sister ship to H.M.S. "Folkestone," which was delivered in June last, and the machinery for both these ships, which is of the single-reduction geared turbine type with oil-fired water-tube boilers, was supplied by R. and W. Hawthorn, Leslie and Co., Ltd., of St. Peter's Works, Newcastle-on-Tyne.

Nautical Surveyors.—A competitive examination for one or more appointments as nautical surveyor under the Board of Trade will be held in London on November 4th, 1930. The limits of age are from twenty-five to forty-five years; the salary is from £300 to £500 plus bonus, which is at present £123 on a salary of £300. Candidates must possess a foreign-going master's or extra master's certificate of competency and must have been in command of a foreign-going merchant steamship. Applications are to be made not later than September 12th on the special forms obtainable from the Senior Staff Officer, Establishment Department (Mercantile Marine Branch), Board of Trade, Great George-street, London, S.W. 1.

Whitworth Society.—The summer meeting of the Whitworth Society was held at Crewe on Tuesday, July 29th. The President, Mr. W. H. Fowler, of Manchester, presided at luncheon, when fifty-four members were present. He inducted into the chair Sir Henry Fowler, C.B.E., Chief Mechanical Engineer, L.M. and S. Railway Company, the new President of the Society. At the luncheon it was announced that the Society had made a grant of £25 to the Royal Technical College, Glasgow, to be expended in Whitworth Society Prizes, and the Founder of the Society, Dr. Hele-Shaw, F.R.S., explained his proposals for the future allocation of such prizes. These proposals were unanimously approved by the members present. The luncheon was followed by an inspection of the Crewe locomotive works, under the guidance of the President and members of his staff. The annual commemoration dinner will be held in London on March 18th, 1931. Further details may be obtained from the Hon. Secretary, Whitworth Society, c/o Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1.

Septic Poisoning in the Machine Shop—The menace of septic poisoning is one which continually confronts all shop managements in varying degrees of severity, the insidiousness of its attack and potential danger ranking it with the most deadly of industrial diseases. Most shop managements are familiar with the periodic epidemic of rashes, pimples and boils which occur amongst operators of automatic machines using an oil coolant, and it is certain that this infection originates from bacteria developed in the oil, which is liable to become infected by outside contamination during its long period of use. Alfred Herbert, Ltd., of Coventry, claims that the problem of the sterilisation of cutting oil has recently been completely solved after many months of co-operative research between it and a firm of manufacturing chemists. A new compound named "Dibactol," which is a powerful germicide and antiseptic, has, it is explained, been perfected. It has the desirable quality that it mixes readily with cutting oil without losing its activity, and the addition of only 1 per cent. of this compound is sufficient, it is stated, to destroy all harmful germ life in cutting oil, whilst its presence has no bad effect on the operator's skin.